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VOLUME 31 1965

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NATIONAL BOTANIC GARDENS OF
SOUTH AFRICA
Kirstenbosch, Newlands, Cape Province

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NATIONAL BOTANIC GARDENS OF SOUTH AFRICA

Kirstenbosch, Newlands, Cape Province

EDITOR

H. B. RYCROFT,

M.Sc. (S.Af.), B.Sc. For. (Stell.), Ph.D. (Cape Town.), F.L.S., F.R.S. (S.Af.)

DIRECTOR OF THE NATIONAL BOTANIC GARDENS OF SOUTH AFRICA

HAROLD PEARSON PROFESSOR OF BOTANY IN THE UNIVERSITY OF CAPE TOWN

NATIONAL BOTANIC GARDENS OF SOUTH AFRICA

The National Botanic Gardens were established in 1913 by unanimous resolution of the Parliament of the Union of South Africa; Kirstenbosch, part of the Groote Schuur Estate at Cape Town bequeathed to the natio by Cecil Rhodes, being chosen as the site and reserved by the Union Gove ment for this purpose.

The Upper Kirstenbosch Nature Reserve, Table Mountain, was placed under the same control in 1922 for the better protection of the native vegetation.

The Karoo Garden at Whitehill was established by private benefaction in 1921. A new site was given by the Worcester Municipality in 1945 and the work was transferred there in 1946.

The Harold Porter Botanic Reserve at Betty's Bay was bequeathed by the late Harold Nixon Porter and placed under the control of the National Botanic Gardens of South Africa in 1959.

The Darling Flora Reserve and the Cape Flats Flora Reserve were acquired by private donation in 1957.

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The Society, founded in 1913, and now consisting of over 3,500 subscribing members in all parts of South Africa and in other countries, exists primarily to give general and financial support to the work of Kirstenbosch and Worcester. The whole of its annual income, after paying expenses, is granted to the Trustees of the Gardens for current expenditure; and the sums accumulating in its fund from the subscriptions of life members are also granted to the Trustees for special pieces of development. Members of the Botanical Society enjoy certain privileges which include participation in the scheme of free distribution of surplus seed from Kirstenbosch and the Karoo Garden.

The President of the Botanical Society is Mr. Dudley R. D'Ewes; the Vice-Presidents are Mr. C. J. Sibbett, Professor H. B. Rycroft and Professor R. H. Compton, and there is a council of fifteen.

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JOURNAL OF SOUTH AFRICAN BOTANY

The Trustees of the National Botanic Gardens of South Africa have undertaken responsibility for the publication of the JOURNAL OF SOUTH AFRICAN BOTANY. This periodical publishes contributions embodying the results of botanical research in any of the various branches of the science. It provides a medium for the publication of work on the South African flora whether systematic, ecological, morphological or otherwise, and whether carried out in South Africa or in other countries; and also on botanical subjects of special interest and application in South Africa.

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PLANT ECOLOGY OF THE GRAHAMSTOWN NATURE RESERVE

I. PRIMARY COMMUNITIES AND PLANT SUCCESSION

A. R. H. Martin
(*University of Sydney, N.S.W., Australia*)

(With Plates I — IX)

ABSTRACT

Two hundred south-facing acres of admixed temperate rainforest, heath and grassland, at an altitude of 1,800—2,500 ft., on quartzite-derived soils in the Grahamstown hills, Eastern Cape Province, South Africa, were dedicated as a Reserve in 1932. This is the first published account of the vegetation. Soils are sandy loams, acid, weakly podsolic with low humus content and non-nitrifying except in forest and a few favoured sites where pH, organic matter and water content are higher. Community types rather than associations are recognised, as there is no firm classificatory basis of Eastern Province associations to which they may be referred. The community types are referred to six physiographic groups, those of ridges and cliffs, dripping rock outcrops, boulder talus, hill slopes, gullies and seeps, and aquatic conditions. For the majority of community types recognised, species lists and subjective frequency values are given. For forest and scrub, data derived from unpublished transect work of 1932 are given. In discussion, evidence is adduced to show that forest is tending to spread. The Raunkiaer life form spectrum for the entire flora of the Reserve (691 spp.) is given. The most interesting feature of this is the high percentage of hemicryptophytes and chamaephytes, despite the dominance of nanophanerophyte heath and of forest over most of the Reserve. A possible reason for this is the very marginal nature of the climate for heath and forest, with a susceptibility to drought and winter fire.

INTRODUCTION

The Grahamstown Nature Reserve consists of about 200 acres of forest, heath and grassland, situated on the south-facing scarp slope of the Grahamstown hills, which rise to a maximum height of 2,535 ft. (760 m.) at the Survey beacon on Dassie Krantz, the highest point of the Reserve (text fig. 1).

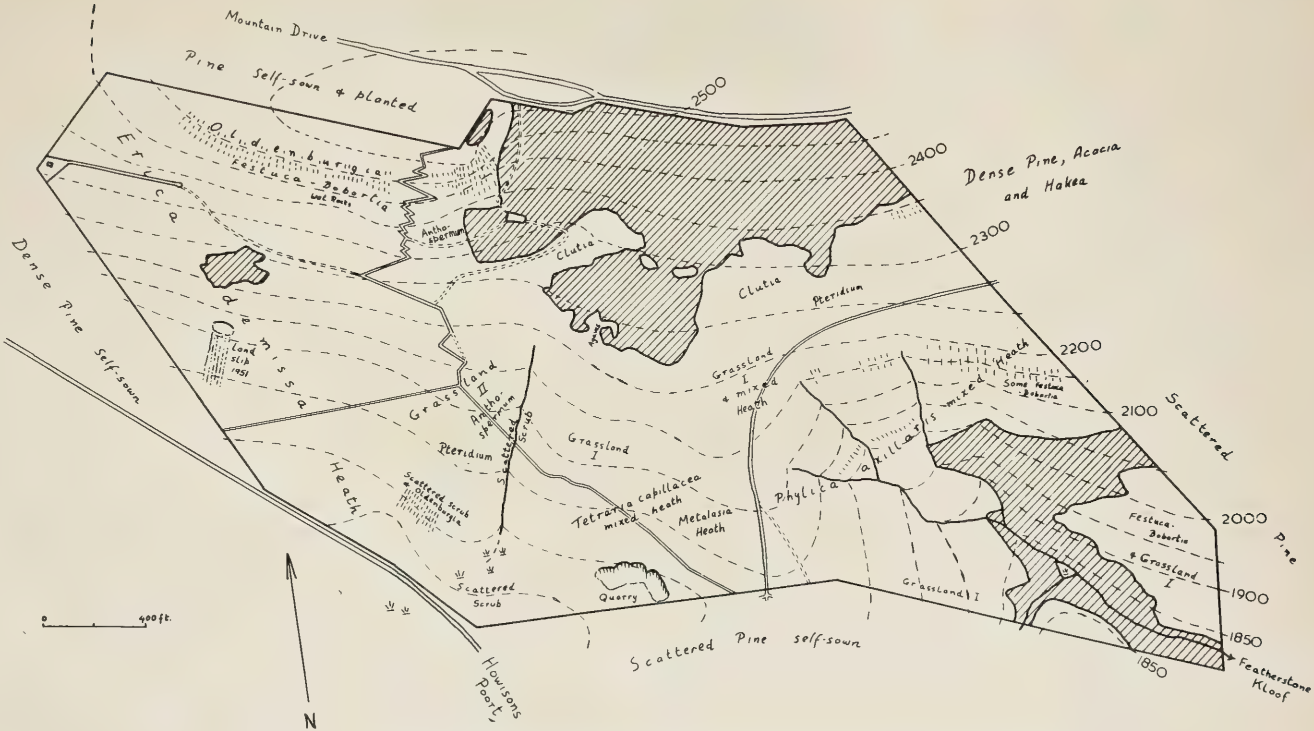
This area was divided into farms shortly after the establishment of Grahamstown in 1812. It was first surveyed in 1827. From this it appears that the Reserve then formed part of the large farm Kowiefontein. This farm was soon subdivided, for the south slope of the ridge, the western end of which forms the Reserve, is shown divided among four owners by 1834 (Cory, 1913). It is clear from this early map that two of these farms, those of Best and Ulyate, bi-sected the Reserve. In 1903 however, ownership of the whole of the ridge reverted to the Grahamstown Municipality, by whom it is still owned as part of the City commonage, grazing rights being leased to individuals. On the 18th April, 1932, through the efforts of the Grahamstown Nature Reserve Society, part of the ridge was declared a nature reserve. The Reserve was not enclosed by fences and firebreaks until some years later, so that some uncontrolled grazing continued for a few years. Conditions of the lease still permit grazing of about 7 head of cattle (theoretically 1 cow to about 30 acres, but not the whole of the area is equally accessible or palatable to grazing cattle), and periodically goats have entered the Reserve. Nonetheless, grazing must have been relatively light for about 25 years.

The vegetation of the Reserve was under observation from 1948 to 1952, and again during 1955 and 1956. Some unpublished data collected at the time of establishment of the Reserve (Liebenberg, 1933; Scott, Norval and Liebenberg, 1933) and photographs held by the Botany Department, Rhodes University, were also studied. These make possible a certain degree of comparison of the state of the vegetation over the twenty-five year period.

GEOLOGY AND TOPOGRAPHY

The hilly, almost mountainous region of Central Albany is formed mainly of Witteberg quartzites and is an extension of the Zuurberg Range further to the west, continued into Albany as the Highlands Range and the Grahamstown Hills, which end at Manleys Flat some 8 miles east of Grahamstown. The Grahamstown Hills are geologically rather uniform in composition. The strata of the quartzites have approximately a 5° dip northwards at this point. Surface silcrete occurs in places on the northerly slopes, but is absent from the scarp side of the range (Mountain, 1946).

Topographically, the part of the Grahamstown Hills on which the Reserve is established forms a unit, bounded on the west by the valley of Howisons



TEXT FIG. 1.—Map of Grahamstown Nature Reserve, based on aerial photography and ground survey, with sketched-in form lines (heights in ft.) and vegetation distribution.

Poort, heading at Waainek, which cuts through the range in a roughly north-south direction, and on the east by a similar lateral valley which the old Kowie Road follows down to the Lower Albany Plain. Into this valley runs Featherstones Kloof to join the Kowie River. A slight col at about 1,900 ft. separates the two.

The Witteberg overlies the Bokkeveld beds which are exposed in the floors of Howisons Poort and Featherstones Kloof, and should underlie the lower end of the Reserve at about 1,800 ft.—1,900 ft. However, they do not appear to be exposed, being covered by a thick layer of large boulders from the Witteberg, some seen in the road cuttings in Howisons Poort, perhaps weighing 50 to 100 tons. Thus the Bokkeveld beds have not participated greatly in soil formation in the Reserve.

The landscape owes its features to the dissection of a once more or less flat surface of late Mesozoic age, the tableland of which has been reduced to a series of ridges with a general height of 2,400—2,500 ft. Drainage is in the main antecedent, but the landscape is moderately young—the valleys being steepsided and the spurs of adjacent hillsides interlocking. These features must be due to the uplift of the land at the end of the Pliocene, estimated to have been about 1,000 ft., which has rejuvenated the river systems.

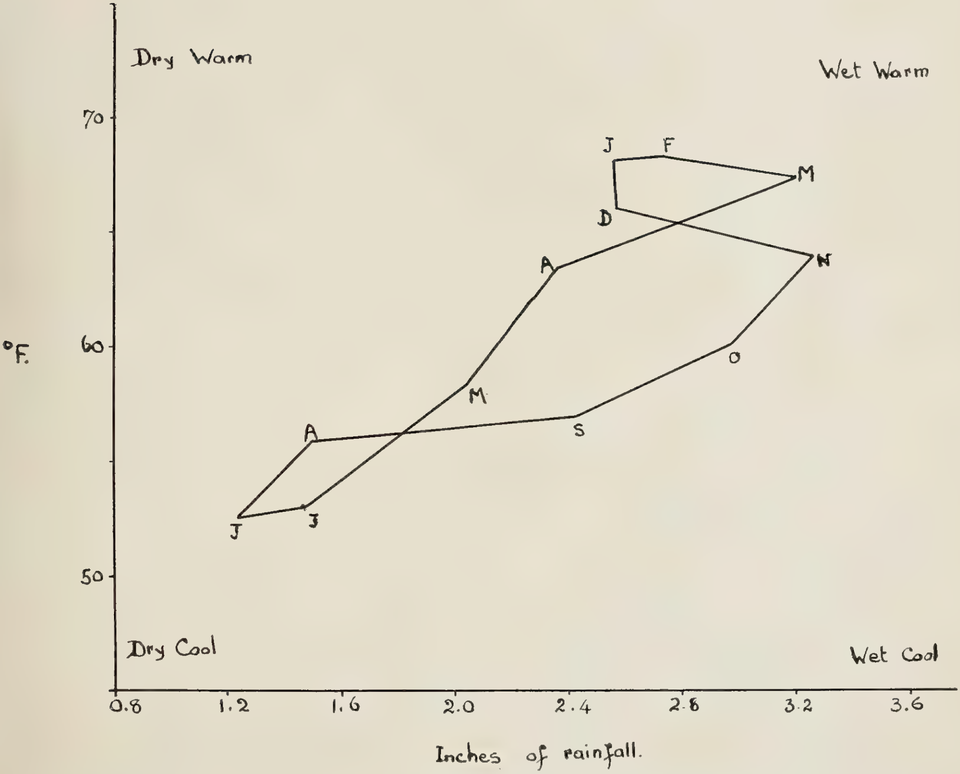
The Witteberg is divided into harder and softer strata, and as these lie nearly horizontally at this point, denudation following the rejuvenation has resulted in an uneven topography, the hard greyish-white quartzites giving rise in places to cliffs or reef-like ridges, or else steep slopes with numerous rock outcrops. At other levels a softer brown ferruginous and sometimes micaceous sandstone has given rise to gentler slopes, mostly vegetation- and soil-covered and lacking outcrops, but sometimes covered with shallow soils exposing surfaces of small sandstone fragments, probably the result of former soil erosion.

Small gullies or larger kloofs have cut back into the hillsides laterally, waterfalls often originating where they cross the harder strata. These kloofs are probably the product of the same Plio-Pleistocene land elevation.

Very little aggradation occurs within the mountain area; although most of the streams have conglomerate-like deposits of Witteberg boulders and pebbles along their banks, alluvial plains of any size are not formed until the plain of Lower Albany is reached.

CLIMATE

It is a pity that meteorological data have never been kept for the Reserve. In lieu of these, a climogram for Grahamstown is presented (text fig. 2), from which it can be seen that a cool, rather dry winter usually alternates with a warm, moderately moist summer. The spring and autumn months appear to be the periods most suited to plant growth. More detailed data are given by Dyer (1937) and Liebenberg (1933). It is well known that in South Africa, climatic conditions can vary surprisingly over a small area, and while the Grahamstown meteorological station is only three miles away, the Reserve, owing to its prominent southerly slope and higher altitude and the fact that it faces the winds from the sea, is cooler and probably wetter than Grahamstown.



TEXT FIG. 2.—Climogram based on mean monthly rainfall and temperature figures for Grahamstown.

In winter, parts of the Reserve remain in shadow throughout the day, others for a large part of it. Dew appears to be heavier and lies longer. Mist, which seldom reaches Grahamstown, often lies on the ridge. It is probable, but not certain, that the rainfall on the south-facing slope is slightly higher than in Grahamstown, which may suffer from a slight rainshadow effect. It is quite certain, however, that aspect plays an important part in the delimitation of plant communities on this ridge. Increased exposure to wind must to some extent nullify the effect of a better effective rainfall as the crest is approached.

SOILS

TABLE I

MECHANICAL ANALYSIS OF GRAHAMSTOWN NATURE RESERVE SOIL, MOIST HEATH TYPE

	Gravel	Coarse sand	Fine sand	Silt	Clay	Loss on ignition	Moisture Equiv.
Percentage	6	32	29	7·5	27·5	13	22

Moisture equivalent determined by Bouyoucos method.

TABLE II

CHEMICAL ANALYSES OF WITTEBERG QUARTZITE SOILS (ALBANY DIVISION)

	Per-centage	Locality	Notes	Analyst
P_2O_5 ..	0·0149	"Near Grahamstown"	Mean of 64 determinations on 1/40 acre plot. HCl extract, (?) total salts	Barker & Steyn 1956
N	0·1016			
K_2O ..	0·134			
P_2O_5 ..	0·0014	Westhoe, Highlands	Mean of two determinations from adjacent camps. N/20 HCl extract, available salts.	Henrici, 1934
N	0·112			
CaO ..	0·125			
pH				
Heath ..	5·0—5·9 (5·6)	Grahamstown Nature Reserve	Mode and range of 15 determinations	Author's data
Grass ..	5·8—6·0 (5·9)		Mode and range of 6 determinations	
Forest ..	6·1—6·6		Range of 3 determinations	

The soils of the Reserve are derived from the slow-weathering parent Witteberg rock. As such they are rather sandy, acid and poor in most nutrients, especially phosphate, calcium and nitrogen. Henrici (1934) considered phosphate to be usually more limiting than nitrogen in Albany soils. The soils are sandy loams, bordering on sandy clay loams (Table I), with low to moderate organic content (loss on ignition 4 to 6% under heath rising to 10 to 15% under forest), with a pH of 5·0 to 6·6, averaging 5·7 (Table II). These soils rather easily lose crumb structure and become compacted and erodable. No part of the Reserve has accumulated a deep soil, owing to the slope. The profile is more or less immature, or even skeletal. The depth may be as little as 3 inches and is rarely more than 2 ft. (phot. 1). There is generally a layer of unweathered quartzite boulders over the solid rock. Near the top of the ridge the surface consists in places of blocks of scarcely weathered quartzite, the faces of which bear only lichens, while vascular plants have colonised the soil pockets between the blocks. Owing to the high relief and sandy soil, drainage is rapid. After heavy rain, streams fed by small springs carry off the water for a few days, but soon dry up. The soils are not highly leached, as is shown by the weak development of soil horizons, even in the deepest profile seen, about 4 ft. Probably prolonged gravitational creep and descent of rock material from higher up the hillside is replenishing the loss by leaching. It is noticeable that even under well-developed and apparently stable forest, the surface soils contain coarse gravel and occasional small boulders. Nevertheless, the soils are weakly podsolised and classifiable (Van der Merwe 1941) as grey podsolics, the podsolisation even in the deeper profiles sometimes showing only as a weak accumulation of the clay fraction, at a depth of about 12 inches in a vestigial B horizon without change in soil colour.

The nitrifying ability of samples from several vegetation types was determined by the diphenol sulphonic acid method of Olsen (1923) (Table III). The percentage change on storage (not the absolute value) defines the power of nitrification or denitrification. It was found that below 2 p.p.m. the method was not very reliable, owing to a slight background colouring of the samples. The *Festuca-Bobartia* heath and the four *Erica* heath samples are remarkably similar except in water content. Among the nitrifying samples, it is interesting to see the majority of the grassland samples. They are not otherwise differentiated, water content, loss on ignition and pH being comparable with the non-nitrifying samples. In this group too, comes the *Anthospermum-Rubus* community. The forest soil, on the other hand, has high pH, water content and loss on ignition, and is well differentiated from the other types. The *Adenocline-Zantedeschia*-Sedge community below Dassie Krantz calls for special comment as being the only sample with high initial nitrate. Its nitrifying ability is not outstanding considering this high initial value, which is probably due to nitrogen contributions by the colony of coneys (*Procavia*) living in the talus below the krantz.

TABLE III

NITRIFICATION IN GRAHAMSTOWN NATURE RESERVE SOILS

	p.p.m. NO_3		Percentage H_2O	Loss on ignition	pH
	Immediate	After 30 days			
1. *Non-nitrifying soils*					
Unburnt *Erica* (*a*)	0·9	1·5	10·21	4·17	5·54
heath, western end (*b*)	2·7	0·7	10·52	5·13	5·56
of Reserve (*c*)	2·9	0·6	14·17	5·99	5·59
(*d*)	1·0	1·4	18·94	6·63	5·53
Metalasia muricata heath with much grass ..	3·7	0·8	19·32	3·88	5·89
Tall tussock grassland ..	2·3	1·2	15·21	4·53	5·94
Festuca-Bobartia heath with *Phylica*	1·0	1·8	21·78	6·12	5·65
2. *Nitrifying soils*					
Stream bed community ..	7·6	37·8	33·72	8·95	5·62
Anthospermum-Rubus community overlooking preceding	1·6	11·8	17·47	3·98	6·02
Adenocline-Zantedeschia Sedge community below Dassie Krantz	26·8	84·7	26·22	4·75	6·13
Forest adjacent to preceding	5·5	47·0	29·79	9·80	6·16
Small forest patch, western end	5·1	68·6	27·76	12·84	6·62
Low tussock grassland, *Digitaria*	0·7	8·3	17·09	4·83	5·83
Grassy clearing in forest	4·3	41·9	17·45	2·67	5·96
Low tussock grassland, *Sporobolus* and *Trifolium*	1·9	7·8	19·21	3·20	6·02

THE VEGETATIONAL HISTORY OF THE RESERVE, AND PLANT SUCCESSION

The vegetation of the north and south-facing slopes of the Grahamstown Hills differs strikingly, and this difference is probably of long standing. Paintings of about 1840 show the north-facing slopes grass-clad and bare of trees, and while no pictorial record exists clearly showing the condition of the south slopes, the indication is that they have for a long time borne low forest—at least in the more sheltered kloofs—and heath. Photographs show pine plantations already established on the north slopes as far as the crests by 1900, and some selfsown saplings already developing. These trees, together with *Acacia longi-*

folia (Australian Wattle) now cover the greater part of the north slopes near Grahamstown, and the original flora can only be inferred by comparison with the still grass-clad slopes further west and east. Photographs show the western end of the south slope (Howisons Poort and Waainek) to be heath heavily invaded by pines by 1930. Pines, *Acacia longifolia* and some *Hakea acicularis* are still encroaching on this slope and on the farther ridge. *Pinus pinaster* is especially fast growing, and enjoys widespread wind dispersal of its abundant seed, so that it spreads rapidly from its centres at the top of the ridge. *P. halepensis* also occurs but is much less frequent. The major effect of pines has been to lower soil pH, accelerate podsolisation and to modify the flora (Seagrief 1950) and the soil fauna (Watts 1951).

One of the first concerns of the Nature Reserve Society was to eradicate the invading species. Clearing was achieved by volunteers, partly by felling and uprooting and partly by use of fire. Stumps of well-grown pines up to 12″ diameter were common in the heath prior to the most recent burnings, and all those examined bore the marks of former burning, which probably took place at about the time of establishment of the Reserve. As the oldest plants of *Erica demissa* examined were about 20 years old, it is likely that at least a good deal of the heath examined between 1948 and 1956 was first established shortly after this burning.

Physiographically considered, the vegetation occupies a land surface probably of Late Mesozoic origin, rejuvenated and dissected in the Late Tertiary. Bearing in mind this geomorphological history, six chief categories of surface for primary succession are recognised, each possessing a distinct plant community grouping, related to the physiographic processes whereby the surfaces originated.

(1) **Steep rocky slopes, cliffs and ridges,** e.g. Dassie Krantz. Small valleys which enter the main ones at right angles may eventually create cliffs, facing more or less east or west, at the points where they cut through the harder bands. Where hard horizontal layers of quartzite occur, erosion results in their exposure as south-facing outcrops; where the larger valleys are cut down well below the level of these they form cliffs or ridges, running more or less east-west. Dassie Krantz however falls into neither of these groups. It represents a sudden step forward in the general line of the scarp as if faulting had occurred. However, no clear geological evidence of faulting is present. *Community types:* predominantly chasmophytic communities.

(2) **Wet rocks or dripping rock ledges.** (*a*) Where insequent streams cut back over a harder band of rock, a small waterfall originates. It may be supposed that at a later stage of dissection, a kloof will form in these places with a cliff on either side, while the waterfall may persist as long as the stream flows over the

hard stratum. Within the Reserve no examples of this type occur, though they are not uncommon in the Albany Ranges. *Community types:* absent in the Reserve.

(*b*) Where seepage of water occurs along joint-planes, small springs often occur and gravitational slumping of the wet soil may expose the underlying rock. In this way a wet rock surface originates, from the surface or top of which water drips at least periodically. The continued action of spring water may start a gully below the rock outcrop. Such an outcrop will only persist if the rock is of harder type. *Community types:* moss mats and wet heath. The difference between (*a*) and (*b*) is perhaps slight. It is probable that on the south slopes of the range gullies have arisen through water erosion from wet flushes and seeps, as well as by the cutting back, or stream head erosion, of pre-existing gullies from below.

(3) **Boulder talus below cliffs.** Below the larger cliffs a boulder talus accumulates in which *Procavia*, the coney or dassie, makes its home. *Community types:* chasmophytic, herbaceous sciophytes and scrub.

(4) **Weathered hill slopes.** Softer rock horizons are weathered as they outcrop, and this weathered material forms the greater part of the hill slopes. Locally, gravitation of partly weathered rubble or of soil results in slow creep down the hillsides, or earth slips, but large landslides must be rare. *Community types:* main grassland and heath communities of Reserve, some forest.

(5) **Areas of drainage concentration**—banks of gullies, flushes and slumps. Areas of increased soil water content can arise in several ways: (*a*) by the issue of water from the rock into the subsoil forming a flush or seep; (*b*) consequent slumping of the wet surface soil or rock debris, producing slight hollows with drainage impeded by the lip. In the more extreme cases an earthslip may result (phot. 17); (*c*) the conformation of the ground causing channelling of water drainage into lines of sub-surface flow, which tend to form gullies; (*d*) deepening and cutting back of existing gullies; (*e*) outcrops of impermeable strata leading to perched water tables above them, often associated with shrub growth. *Community types:* Hygrophytic heath and grassland, and some scrub and forest.

(6) **Areas of open water and silting.** Large bodies of water do not accumulate and small bodies do not persist long. Nonetheless, along the lower parts of the two main streams draining the Reserve, flow is sufficiently perennial for marshy conditions to develop. *Community types:* hygrophytic heath, grassland and sedge with some helophytes but no true hydrophytic communities.

Owing to the slow rate of origin of new bare areas and the slow-weathering nature of the Witteberg, it is hard to identify successional stages of seres on these surfaces; moreover, the sere on dry rocks proceeds far more slowly than that on wet rock or talus, and the sere on the slower weathering harder strata must proceed more slowly than that on the more rapidly weathering hill-slopes. Thus on cliffs, vegetation may remain unstable for a long time, even after a scrub of forest species has become established on the cliff face, while on the gentler slopes a relatively stable heath of leptophyllous ericoid species develops as soil accumulates round and above the variously shaped and sized boulders, which gradually weather into smaller particles. Initial stages of plant succession are few and often mixed in a mosaic with later stages, forming a cosere (Clements 1916) which is difficult to interpret.

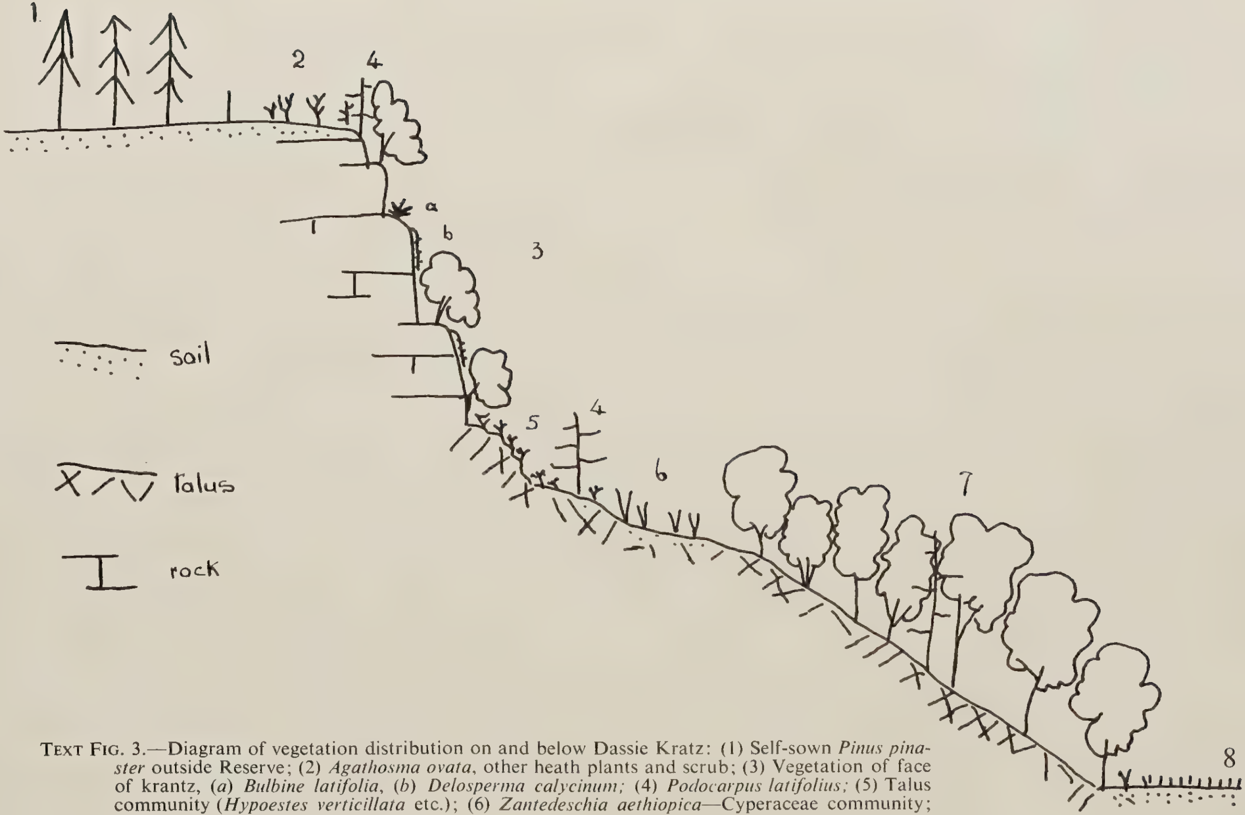
TYPES OF VEGETATION PRESENT IN THE RESERVE

The term "vegetation-type" or "community-type" is used here rather than "association" because in an area of such small extent, and in the absence of any comparison with other parts of the Grahamstown Hills and other Witteberg ridges, it is difficult to distinguish between widespread and recurring vegetation types and those that are purely local or fortuitous.

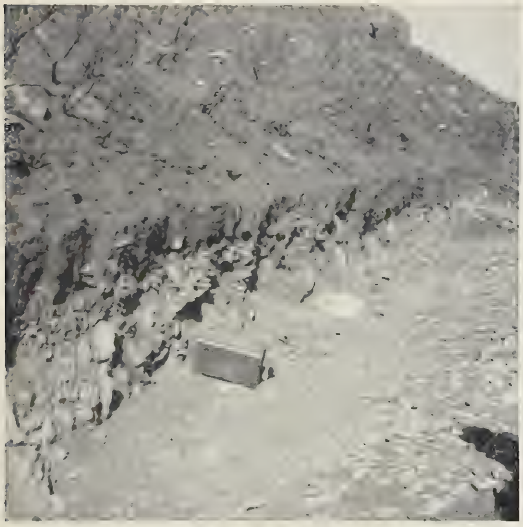
(1) Community Types of Steep Rocky Slopes, Cliffs and Ridges

Dassie Krantz is the only large rock face on the Reserve. The vegetation of small outcrops is only considered insofar as it differs from that of Dassie Krantz. The top of Dassie Krantz stands 2,535 ft. above sea-level. The foot of the krantz is about 120 ft. lower, the greater part of this drop being in the form of more or less vertical drops of up to 30 ft. at a time, separated by shelf-like steps or ledges. Despite the steepness, a large part of the krantz is vegetated. A sketch section of the krantz is given in text fig. 3.

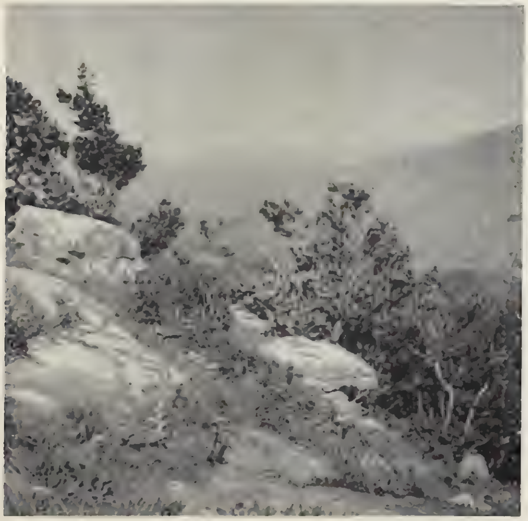
The vertical rock faces on the krantz bear mainly *Usnea* and *Ramalina* spp. *Hypnum cupressiforme* rarely becomes established on bare rock, but is frequent on ledges with a minimum of soil. Minute crevices may contain *Lycopodium gnidioides*. At the top of the krantz, *Crassula rosularis*, *Disperis micrantha*, *Ficinia* sp., *Holothrix lindleyana*, *H. villosa* and *Othonna carnosa* form definite crevice soil communities, mainly of rosette plants, corresponding to Warming's (1909) "rosette chasmophytes". *Bulbine latifolia* is a larger and more robust succulent rosette plant, which seems to form distinct communities. It may possibly be successional to the smaller rosette communities, but this has not been clearly shown. On these ledges with shallow soil, scrub of *Ficus burt-davyi*, *Allophylus decipiens* and *Pleomele hookeriana* seem to become established directly in the wake of the pioneers.



TEXT FIG. 3.—Diagram of vegetation distribution on and below Dassie Kratz: (1) Self-sown *Pinus pinaster* outside Reserve; (2) *Agathosma ovata*, other heath plants and scrub; (3) Vegetation of face of krantz, (*a*) *Bulbine latifolia*, (*b*) *Delosperma calycinum;* (4) *Podocarpus latifolius;* (5) Talus community (*Hypoestes verticillata* etc.); (6) *Zantedeschia aethiopica*—Cyperaceae community; (7) Evergreen forest; (8) Grassy clearing.



Phot. 1.—Soil profile on Nature Reserve (burnt area): shallow A and B horizons not strongly differentiated, passing into C horizon with angular rock fragments, a product of gravitational transport at an earlier period of erosion. Note also similar surface boulders, resulting from more recent gravitational movement.



Phot. 2.—*Oldenburgia* and *Podocarpus latifolius* together at upper western side of Dassie Krantz. In foreground open "ridge" vegetation of *Carpobrotus edulis* and small herbs and shrubs in shallow soil between flat boulders covered with encrusting lichens.

Plate I

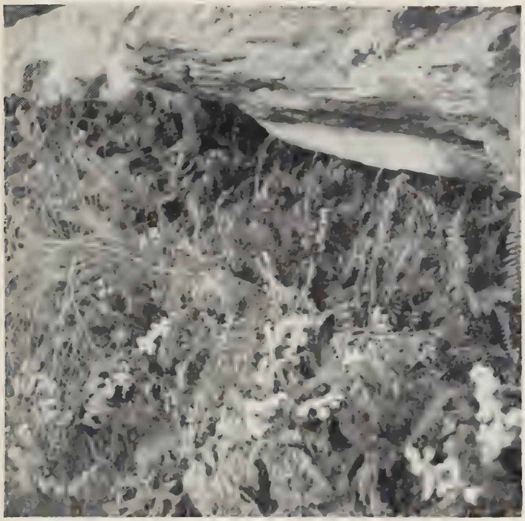
Table IV
FLORA OF THE FACE OF DASSIE KRANTZ

Allophylus decipiens
Bulbine latifolia
Chenopodium sp.
Coccinea quinqueloba
Crassula lactea
C. nemorosa
C. perforata
Delosperma calycinum
Ficus burtt-davyi
Grewia occidentalis
Haemanthus albiflos
Lycium ferocissimum
Melothria punctata
Pleomele hookeriana
Podocarpus latifolius (mainly at edges)
Senecio angulatus
S. mikanioides
Lichens
Leptogium sp.
Parmelia hottentotta
Parmelia sp.
Ramalina sp.
Usnea sp.

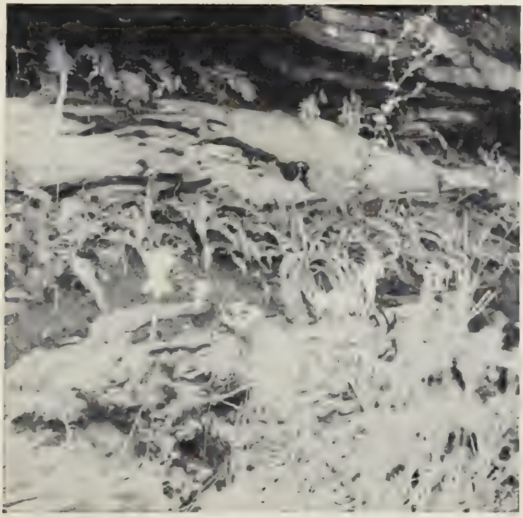
Vegetation of other steep dry rocks is similar to Dassie Krantz, but two distinct communities occur. (*a*) Where the slope is at all northerly, as in one or two places along the ridge west of Dassie Krantz and on one of the spur ridges lower down, *Crassula falcata* and *Pellaea calomelanos* are present. These species were never found on south-facing slopes. (*b*) Where the outcrop of rock forms a horizontal reef-like exposure along the hillside, this is marked by lines of the tree Composite *Oldenburgia arbuscula*, which may be regarded as physiognomically the dominant of a distinct community-type. *Oldenburgia* is absent from the face of Dassie Krantz itself, although common at the sides and just above the cliff (phot. 2). This may be due to instability of the cliff

Table V
FLORA OF OLDENBURGIA COMMUNITY

Adenocline bupleuroides	o	*Ficinea indica*	o–f
Agapanthus africanus	l.c.	*Ficus ingens*	r
Amphithalea phylicoides	v.r.	*Grewia occidentalis*	f
Aspalathus chortophila	o	*Haworthia monticola* var. *albanensis*	o
Asparagus sarmentosus	o–f	*Knowltonia capensis*	o
Bulbine latifolia	f	*Lampranthus spectabilis*	f
Caesia eckloniana	r	*Montinia caryophyllacea*	o–f
Cineraria saxifraga	c	*Muraltia macowani*	l.c.
Crassula cultrata	c	*Oldenburgia arbuscula*	d
C. falcata	l	*Osteospermum junceum*	o–f
C. lactea	o–f	*Othonna carnosa*	f
C. obvallata	o–f	*Pellaea calomelanos*	l
Delosperma britteniae	o	*Rafnia elliptica*	o–f
D. calycinum	o–f	*Rhoicissus dimidiata*	o
Ehrhardta erecta	o	*Rhyticarpus difformis*	o
Euclea lanceolata	o–f	*Scilla lancaeafolia*	o–f
Ficinea c.f. *elongata*	f	*Senecio crassiusculus*	o
F. bracteata	f–c	*Streptocarpus meyeri*	o
F. fascicularis	f–c	*Teedia lucida*	r



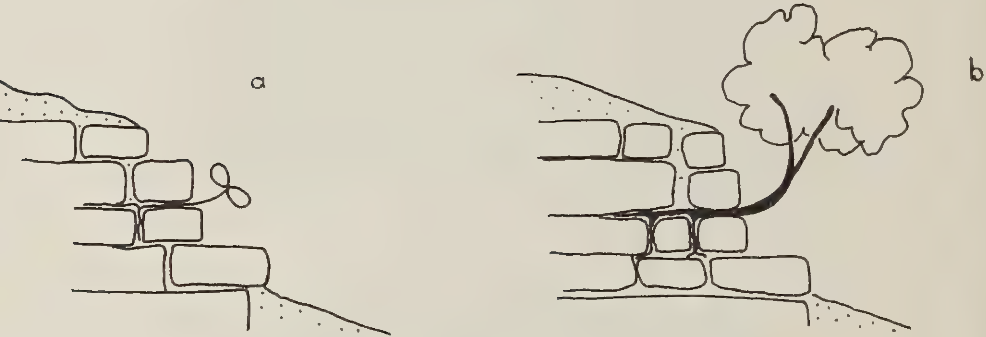
Phot. 3.—*Blechnum australe*, *Helichrysum petiolatum*, *H. orbiculare*, *Ficinea gracilis* and *Clutia affinis* in shelter of overhanging rock ledge.



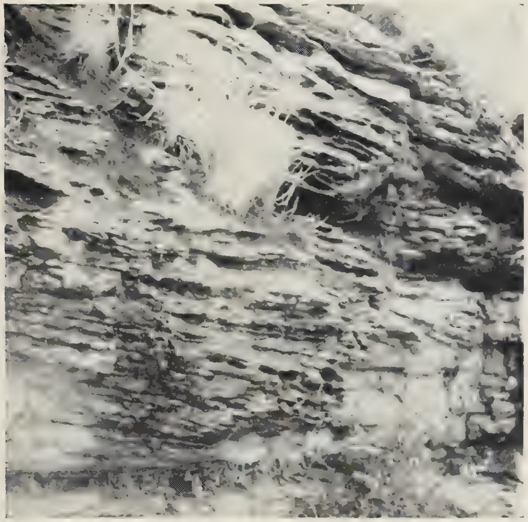
Phot. 4.—Continually moist south-facing rock outcrop. Note crevice flora of *Blechnum australe*, moss mats, and *Hypoxis obliqua*, *Senecio rigidus* and *Ursinea anethoides*. A small plant of *Rapanea melanophloeos* is present.

Plate II

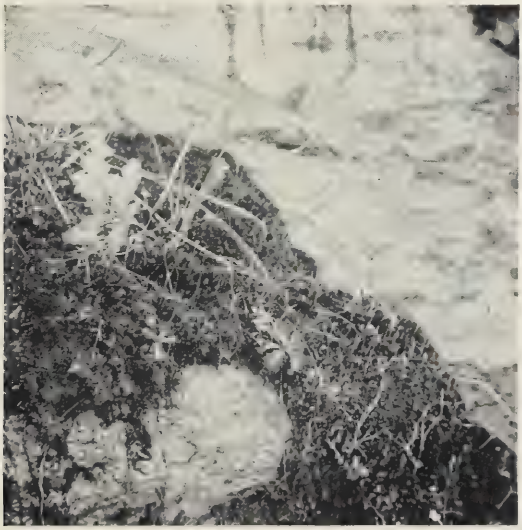
face. Most mature trees of *Oldenburgia* have trunks out of perpendicular. Several instances of collapse of old trees were noted. It seems that as the tree becomes mature, a combination of its own weight and the dislocation of rock slabs by its roots ultimately results in falls of parts of the rock face and of the tree, as in the series of diagrams (text fig. 4) and phot. 16, leading to a cyclical development.



TEXT FIG. 4.—Diagram of erosional cycle associated with *Oldenburgia arbuscula:* (*a*) Juvenile, (*b*) Mature, (*c*) Over-mature, (*d*) Collapse stage.



PHOT. 5.—Same outcrop as in phot. 4, but 50 m. farther west, here only periodically wet. Flora is mainly *Agrostis bergiana* and *Restio triticeus*, with dark mats of *Frullania c. f. lindenbergii*, other Bryophytes and Ferns scarce, and luxuriance of vegetation at base of outcrop restricted.



PHOT. 6.—Flora of wet rock surfaces—mats of *Campylopus* sp. and *Breutelia*, with *Drosera cuneifolia*, *Utricularia capensis* and seedlings of *Erica demissa* and *E. chamissonis*.

PLATE III

(2) Community-types of wet rock outcrops

The development of vegetation on wet rock outcrops seems to depend on the degree of insolation (steep or overhung outcrops have a more sciophilous vegetation), and the volume and periodicity of water flow. The chemical composition of the water has not been closely investigated, but is probably fairly uniform. A complete range between wet and dry rock faces exists and thus a complete range of community-types between the xerarch types described above and the wettest. However, only a few of these appear within the Reserve. Three such sites, somewhat contrasted, but with some common features, are shown in phots. 3, 4 and 5.

Blechnum australe and *Helichrysum orbiculare*, especially the former, constitute a sciophilous community-type, being quite typical of sites where flat ledges of rock project, forming a shaded recess which can only receive direct sunlight when the sun is low in the early morning. No site was observed where late evening sun entered.

Table VI
FLORA OF DRIPPING ROCKS

Agrostis bergiana
Alepidea capensis
Anthospermum aethiopicum
Athrixia crinita
Berzelia intermedia
Bobartia burchellii
Chironia melampyrifolia
Clutia alaternoides
C. heterophylla
Danthonia cincta
Disa sagittalis
Drosera cuneifolia
Erica cerinthoides
E. chamissonis
E. demissa
Festuca costata
Ficinia fascicularis
F. cf. *gracilis*
Gnidia styphelioides
Helichrysum felinum
H. orbiculare
H. petiolatum
Hypoxis obliqua
Leidesia obtusa
Myrsine africana
Ornithogalum bolusianum
Osteopermum junceum
Pelargonium ribifolium
Pinus sp. (dead, burnt sapling)
Psoralea pinnata
Rapanea melanophloeos (sapling, one only)
Restio triticeus
Sebaea hymenosepala
Satyrium sp. (? *membranaceum*)
Senecio concolor
S. pterophorus
S. purpureus
Tetraria capillacea
T. cuspidata
Themeda triandra
Ursinia anethoides
Utricularia capensis
Pteridophyta
Blechnum australe
Bryophyta
Anthoceros sp.
Breutelia sp.
Bartramidula globosa
Calypogeia fusca
Campylopus sp. i
C. sp. ii
Fissidens glaucescens
Frullania lindenbergii
Lepidozia capillaris
Philonotis androgyna
Trematodon pillansii

PHOT. 7.—*Erica chamissonis*, *E. demissa*, young plants of *Disa sagittalis* and *Helichrysum orbiculare* on *Campylopus* mat. Note covering by dry crust of Blue-green algae (Chroöcoccales) on lower right—beginning of degeneration of the mat.

PHOT. 8.—Dassie Krantz boulder talus. *Lampranthus* sp. rooted in crevices and straggling over rocks, *Plectranthus strigosus* and *Hypoëstes verticillaris*. Note thallose lichens on rock surface.

PLATE IV

Plant succession on a ledge in a moist outcrop community (phot. 4) appears to start with the development of a slime of blue-green algae over which moss mats of *Campylopus* sp. and *Breutelia* sp. usually develop. In these mats *Drosera* and *Utricularia* become established, followed by *Agrostis bergiana*, *Alepidea* and seedlings of *Erica demissa*, *Berzelia intermedia*, *Ursinia anethoides*, etc. (Table VI). However, the moss mats often become dried out and moribund, with a horny pellicle consisting of a mixture of gelatinous blue-green algae, mainly *Gloeocapsa* spp. (phot. 6 and 7). Such mats are often washed off the ledge by the first following heavy rain, adding to the depth of soil on the slope below the ledge. Succession then recommences on the bare rock. Gravitational collapse may also occur at the stage of heath establishment, and no stages later than this were observed. Phot. 5 is of a rock surface which is only periodically wet. The flora is much less luxuriant, consisting mainly of *Agrostis bergiana* and *Restio triticeus*. *Blechnum* and Bryophytes, except *Frullania lindenbergii*, are scarce.

(3) COMMUNITY-TYPE OF BOULDER TALUS

There is only one at all extensive talus slope in the Reserve; this is at the base and eastern side of Dassie Krantz.

The abundance of climbing and trailing plants (chasmophytes; Warming, 1909, Schimper, 1903) is remarkable. *Clematis*, *Senecio* spp., Cucurbitaceae spp., *Dioscorea* and *Rubus* illustrate the habit well. Even some species which do not normally straggle do so here, e.g. *Grewia occidentalis* and *Fleurya mitis* (phot. 9). Two successions can be traced: that on rock surfaces, which tends to be lichens → xeric mosses → *Crassula lineolata*, *Cineraria saxifraga* or *Lampranthus* sp. (phot. 8, 9); and that in crevices, which seems to be liverwort mats → annual herbs → perennial herbs, ferns and creepers → shrubs and trees. On this slope a number of shrubs and trees have invaded the tangle: *Podocarpus latifolius* seems to be one of the most successful. None of the plants on the talus slope can be described as leptophyllous nanophanerophytes. Thus, under some circumstances the forest species will colonise bare areas via crevices. A part of the woodland, especially below and at the eastern side of Dassie Krantz, seems to have arisen in this manner (see discussion). On top of the cliff, however, leptophyllous nanophanerophytes (mainly *Agathosma* spp.) form a well-marked stage in succession to scrub.

(4) COMMUNITY TYPES OF THE HILL SLOPES

The slope of the Grahamstown Hills varies from 5° to 30° or more. (Slopes greater than 30° are usually more or less rocky or liable to slumping.) These slopes are occupied by a complex and varied vegetation, including forest, heath and grassland, and small areas of stream bank vegetation. Examples

TABLE VII
FLORA OF THE TALUS BELOW DASSIE KRANTZ

Adenocline acuta
Bulbine latifolia
Carpobrotus edulis
Cerastium capense
Cineraria saxifraga
Clematis brachiata
Coccinea quinqueloba
Cotula heterocarpa
Cotyledon velutina var. *beckeri*
Crassula lineolata
C. marginalis
C. nemorosa
C. spatulata
Delosperma calycinum
Dioscorea sylvatica
Disa sagittalis
Disperis micrantha
Ficinia elongata
Fleurya mitis
Galopina circaeoides
Geranium ornithopodum
Grewia occidentalis
*"*Gymnosporia buxifolia*"
Helichrysum foetidum
H. petiolatum
Hypochoeris radicata
Hypoëstes aristata
Hy. verticillaris
Lampranthus sp.
Leidesia obtusa
Lepidium africanum
Lithospermum officinale
Mariscus owani
Melica racemosa
Myosotis intermedia
Nemesia melissaefolia
Oldenburgia arbuscula
Ornithogalum bolusianum
O. caudatum
Panicum maximum
Peperomia retusa
Plectranthus ciliaris
P. laxiflorus
Plectranthus strigosus
P. thunbergii
Pleomele hookeriana
Podocarpus latifolius
Polycarpon tetraphyllum
Ranunculus multifidus
Rhoicissus cuneifolia
Rubus pinnatus
Rumex sagittatus
Scutia indica
Senecio angulatus
S. deltoideus
S. mikanioides
Solanum nigrum
So. quadrangulare
So. sodomaeum
Stellaria media
Sutera cordata
Sisymbrium capense
Tolpis capensis
Trifolium burchellianum
Vulpia bromoides
Zantedeschia aethiopica
Pteridophyta
Asplenium adiantum-nigrum
A. erectum
A. lunulatum
A. (?) *platyneuron*
Lycopodium gnidioides
Pellaea viridis
Polypodium vulgare
Polystichum adiantiforme
Bryophyta
Aerobryopsis capensis
Bryum capillare
B. sp. aff. *B. rigidicuspis*
Calypogeia fusca
Frullania sp.
Hypnum cupressiforme
Lophocolea bidentata
Plagiochila natalensis
Ptychomitrium crispatum
Triquetrella tristichia

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*W. Marais (Bothalia, 7 (2), 1960, p. 381) includes both *Gymnosporia angularis* (Sond.) Sim and *G. buxifolia* (L) Szysz. in *Maytenus cymosus* (Soland) Exell. I have not seen this paper, and as *G. angularis* on the Reserve is a slightly branched shrub, always found in heath, while *G. buxifolia* is a much branched tree nearly always found in scrub and forest, the two forms being clearly distinguishable, I prefer to identify them by earlier names, not doubting both should be referred to *Maytenus*.

of all these occur in the Nature Reserve. The approximate area occupied by grassland and heath is hard to assess, owing to their occurrence in places in a mosaic. Scrub and low forest occupy about 20% of the area.

(*a*) **Nanophanerophytic heath formation:** *Erica demissa*—mixed heath alliance.

The heath may be divided into a number of communities distinguishable by eye. Certain groupings of species not falling into any of these categories occur, but are too fragmentary and insufficiently well characterised to be named. The major communities are:—

(i) *Erica demissa* heath.
(ii) *E. demissa*—*Phylica axillaris*—other spp. heath.
(iii) *Metalasia muricata* heath.
(iv) *Tetraria capillacea*—mixed dwarf shrub heath.
(v) *Anthospermum aethiopicum* heath.
(vi) *Cliffortia linearifolia* heath.
(vii) *Pteridium* heath.
(viii) *Clutia affinis* heath.
(ix) *Festuca costata*—*Bobartia burchellii* grass-heath.

(i) The *Erica demissa* heath is structurally the most advanced and appears formerly to have occupied a larger area.

The flora is large and as the heath has indistinct margins and occurs in mosaic form with other communities, it is hard to make a list which is inclusive without at once admitting a number of casuals or strays. The following list, which is not complete, comprises most species which regularly occur in mature *E. demissa* heath.

TABLE VIII

FLORA OF MATURE *ERICA DEMISSA* HEATH

Alloteropsis semialata	f–c
Andropogon appendiculatus	o
Anisotoma mollis	o
Anthospermum aethiopicum	f–c
A. lanceolatum	o
A. paniculatum	o–f
Argyrolobium stipulaceum	o
Berkheya carduoides	f
B. decurrens	f
Bobartia burchellii	f
B. indica	l–a
H. nudifolium	c–a
H. petiolatum	l
H. subglomeratum	c–a
Hypoxis obliqua	f
Metalasia muricata	o–f
Myrsine africana	r–o
Ochna atropurpurea	r–o
O. imbricata var. *violacea*	f–a
Oxalis punctata	f–a
O. smithiana	o–f
Pentaschistis angustifolia	f
Pimpinella schlechteri	o–f
Pinus pinaster	r–o
Polygala ohlendorfiana	r

FLORA OF MATURE *ERICA DEMISSA* HEATH *cont.*

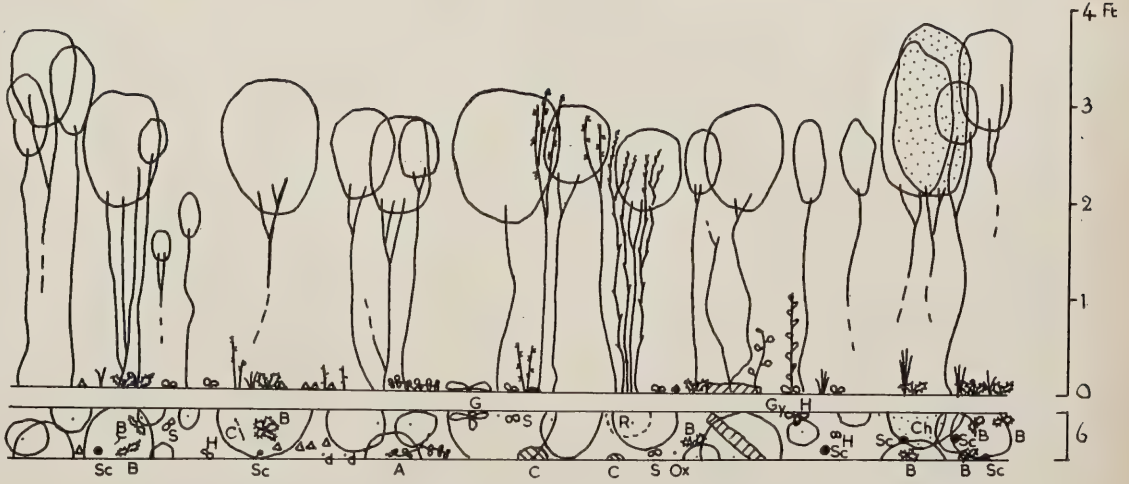
Burchellia bubalina	o
Chaetacanthus setiger	f
Chironia melampyrifolia	r–o
Ch. tetragona	o
Cliffortia linearifolia	c–d
C. repens	o–f
Clutia heterophylla	f
Disparago ericoides	o
Eragrostis curvula	o–f
Erica chamissonis	o–c
E. demissa	a–d
Ficinea stolonifera	o–f
Gerbera viridifolia	f
"*Gymnosporia angularis*"	r–o
Halleria lucida	r
Haplocarpha scaposa	o
Helichrysum appendiculatum	f
H. felinum	f–c
Psoralea spicata	l
Pteridium aquilinum	o–c
Restio sejunctus	o–f
R. triticeus	c
Rhus dentata	r
Rh. eckloniana	o
Rh. fastigiata	o
Rh. lucida	r
Royena pubescens	r–o
Rubus pinnatus	l
Satyrium membranaceum	o
Scabiosa anthemifolia	o-f
Schoenoxiphium sparteum	c
Sebaea sp.	f
Senecio othonnaeflorus	c
Struthiola macowani	o–f
S. parviflora	o
Tephrosia grandiflora	o
Themeda triandra	c–a
Wahlenbergia capillacea	o

Text fig. 5 represents a small portion of a transect in an area of mature *Erica demissa* heath which had not been burnt for about 22 years (that it had been burnt then was shown by the still persisting marks of fire on pine stumps now overgrown by the heath). The mature *E. demissa* forms tall, single-stemmed, narrow-crowned plants about 4—5 ft. in height with stems 1—1½ inches in girth. They comprise about 90% of the plant cover, the rest being made up in the main of *E. chamissonis*, *Cliffortia linearifolia* and *Anthospermum aethiopicum*. In this sample of heath, the only old stand still remaining in the Reserve after the severe 1955 fire, small microphyllous and mesophyllous shrubs, e.g. *Rhus fastigiata*, *Burchellia bubalina* and *Royena* sp., were present. Whether they represent normal constituents of mature heath, or pioneers of a later stage in succession, will be discussed later. Another feature is the occurrence of numerous hemicryptophytes and some geophytes and suffrutices, the former persisting here in the dense shade of the *Erica*. The thin, pale green leaves of these species contrast sharply with those developed in full light: often few and minute, like those of seedlings, they are easily overlooked. However, these leaves are found to be attached to well-developed root or rhizome systems. Most of the hemicryptophytes listed are able to live in tall heath in this fashion.

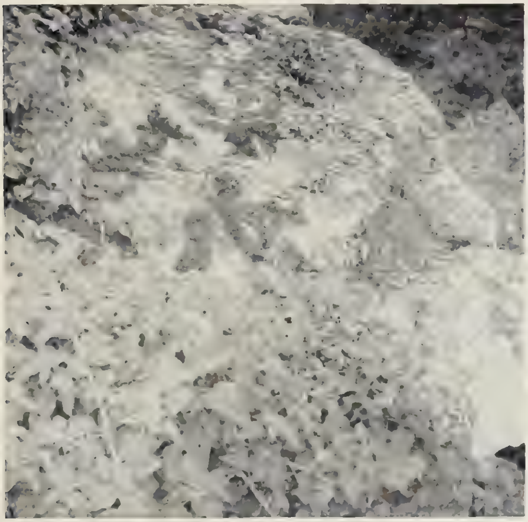
(ii) *Erica demissa—Phylica axillaris*—other spp. heath. The most widespread heath type, at least to 1955, was the *Erica demissa—Phylica axillaris*—other species heath, characterised from the preceding chiefly by the presence of *Phylica axillaris*, but also by *Ursinia anethoides*, *Amphithalea williamsonii* and

KEY to fig. 5

	A	-	Anisotoma mollis
	B		Berkheya carduoides
⊘	C	=	Cliffortia linearifolia
◌	Ch	–	Erica chamissonis
⊙		=	E. demissa
·	d	=	Seedlings of E. demissa
	G	=	Gerbera viridifolia
	Gy	=	Gymnosporia angularis
∞	H	=	Helichrysum subglomeratum
	Ox	=	Oxalis punctata
◌	Ⓡ	=	Restio triticeus
∞	S	=	Senecio concolor
•	Sc	-	Schoenoxipheum sparteum
△		=	Cladonia



TEXT FIG. 5.—Section of 6 in. wide belt transect in undisturbed and apparently mature *Erica demissa* heath. Plan and elevation drawn to scale and semi-naturalistic.



PHOT. 9.—Dassie Krantz boulder talus. *Fleurya mitis* straggling over boulders—note creeping habit of some stems. *Plectranthus* sp. and *Adenocline acuta* also present. On rock note contrasted flora of *Cineraria saxifraga*, *Hypnum cupressiforme* and lichens (*Cladonia*, *Ramalina*, *Teloschistis*, *Parmelia* spp. and small grey encrusting lichen).

PHOT. 10.—*Metalasia muricata* heath. An example of dominance by one species.

PLATE V

a number of other small shrubs included in the following list, derived from analysis of 25 metre quadrats.

Table IX

FLORA OF *ERICA DEMISSA—PHYLICA AXILLARIS* HEATH

Acalypha peduncularis	f–c
Alepidea capensis	c
Alloteropsis semialata	c
Amphithalea williamsonii	o–f
Anthospermum aethiopicum	f–c
Aristida galpinii	f
Athanasia punctata	f
Berkheya carduoides	f
B. decurrens	f
Bobartia burchellii	c
Bo. indica	f
Centella eriantha	f–c
Chaetacanthus setiger	f
Cliffortia repens	o
Clutia heterophylla	c
Cymbopogon marginatus	f
Disparago ericoides	f
Elyonurus argenteus	l.c.
Erica chamissonis	f
E. demissa	c
Eulalia villosa	f
Ficinia sp.	f
Gerbera viridifolia	f
Harpechloa falx	f
Helichrysum anomalum	f
H. appendiculatum	f–c
H. felinum	c
H. nudifolium	c–a
H. subglomeratum	c–a
Hibiscus aethiopicus	o–f
Indigofera stricta	r–o
Metalasia gnaphalodes	l.c.
Phylica axillaris	o–l.d.
Polygala hispida	f
Pteridium aquilinum	o–c
Restio triticeus	f–c
Schoenoxiphium sparteum	c
Senecio othonnaeflorus	c–a
Tephrosia capensis	f
Themeda triandra	a
Tristachya hispida	f
Ursinia anethoides	f–c
Vernonia dregeana	o–f

Rarer plants characteristic of this community are *Helipterum milleflorum*, *Protea cynaroides*, *Psoralea polyphylla* and *Agathosma peglerae*. The structure is more open than that of *E. demissa* heath, the taller heath species do not form a continuous canopy, the height is lower and a larger number of herbs, grasses and small shrubs are present.

(iii) *Metalasia muricata* heath. A single large area of *Metalasia* dominated heath lies between the main *Erica—Phylica* heath and the *Tetraria capillacea* dominated area, as well as a few small patches in the *Erica-Phylica* heath. The type is distinctive, but has not been examined in detail (see phot. 10).

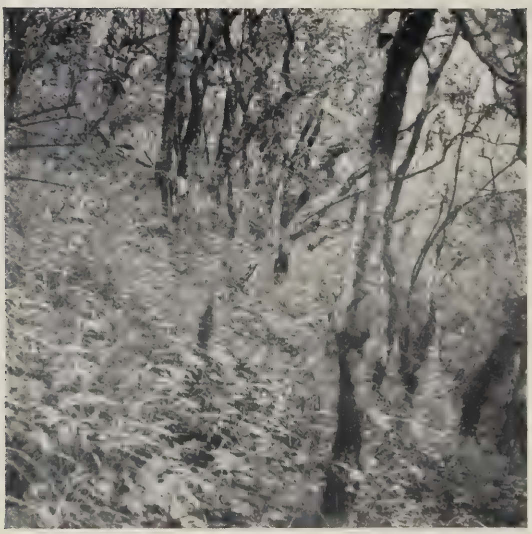
(iv) *Tetraria capillacea*—mixed dwarf shrub heath. This presents a very low-growing, seemingly depauperate open heath type, found mainly on the col between the Howisons Poort and Featherstones Kloof drainage. Its spread down the slope on the Howisons Poort side suggests that exposure to westerly and north-westerly insolation, possibly combined with shallow eroded soils and strong winds, is responsible for its openness. The characteristic plants include a great many chamaephytes.

TABLE X

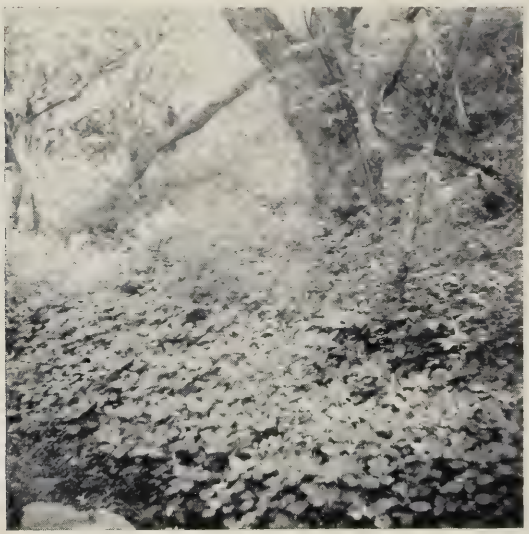
FLORA OF *TETRARIA CAPILLACEA*—MIXED DWARF SHRUB HEATH

Agathosma peglerae	o
Alepidea capensis	f
Amellus strigosus	c
Andropogon appendiculatus	o–f
Anisotoma mollis	o–f
Anthospermum paniculatum	o–f
Argyrolobium spp.	f
Aristea anceps	o
A. pusilla	o–f
Buchnera dura	o
Chaetacanthus setiger	f
Clutia heterophylla	o
Elegia parviflora	l.f.
Eragrostis capensis	f
Erica calycina	v.r.
E. glumaeflora	f
Eriosema salignum	f
Eroeda imbricata	o
Euphorbia striata	o
Ficinia stolonifera	f
Gnidia nodiflora	f
G. sericea	f
Helichrysum squamosum	o
H. subglomeratum	o
Hibiscus aethiopicus	f
Hypericum lalandii	o
Hypoxis obliqua	o
Indigofera fastigiata var. *angustata*	o
I. hilaris	o–f
Leontonyx squarrosus	o
Linum thunbergii	o–f
Leucadendron salignum	o
Lobelia cf. *tomentosa*	c
Osteospermum imbricatum s.sp. *nervatum*	r
Pentaschistis angustifolia	f
Pteronia teretifolia	o
Relhania pungens	f
Restio sejunctus	c
R. triticeus	c
Scabiosa anthemifolia	f
Senecio pinifolius	o
Struthiola argentea	f
Sutera campanulata	c
Tephrosia capensis	c
Tetraria burmannii	v.r.
T. capillacea	l.c.
T. cuspidata	f
Thesium gnideaceum	o
Wahlenbergia capillacea	f

No other heath type has been examined in detail, except the *Festuca—Bobartia* community. Each is characterised by dominance of a single species, mostly the area occupied is small, and probably they owe their origin to disturbance. Thus, pure communities of *Cliffortia linearifolia* arise on cleared firepaths and after fires. *Anthospermum aethiopicum* heath often contains *Hibiscus trionum*, *Selago corymbosa*, *Tephrosia capensis* and *Malvastrum scabrosum*, which tend to behave aggressively, like ruderals, on disturbance of the veld. *Pteridium* is well-known as an invader after disturbance, and while it occurs sporadically in *Erica* heath, it is unlikely to become dominant naturally. *Metalasia* may be an exception, but there is evidence, to be considered in another paper, that burning may have a selective effect on certain species, of which *Metalasia muricata* is one. *Festuca—Bobartia* heath may also be an exception, but here too *Bobartia* is influenced by fires. A *Festuca costata* grassland occurring



PHOT. 11.—Woodland below Dassie Krantz, many trees showing coppice form. Ground flora ill-defined, consisting partly of small saplings; canopy irregular. A young type of woodland.



PHOT. 12.—More mature woodland, showing greater size of trees. Abundant ground flora of *Plectranthus*. Note lianes.

PLATE VI

at altitudes above 6,000 ft. has been described (Acocks, 1953) as *Themeda—Festuca* alpine veld. However, "alpine" is less apposite than "montane" (Adamson, 1938) as few if any of the species are truly alpine in range. Even so, it appears to be below its normal altitudinal range in the present situation. Possibly this grassland type forms a relic of former *Festuca* veld which was dominant on south slopes, steep but with fairly deep soils, often below *Oldenburgia* communities on exposed outcrops higher upslope. Such sites remain in shadow for a large part of the day in winter months and dew lies late. Thus conditions found at higher altitudes may be partly simulated.

The following list includes only the characteristic species. It should be compared with the list given by Acocks (1953), which also includes the supposedly temperate indicators, *Koeleria* and *Poa binata*.

TABLE XI

FLORA OF THE *FESTUCA-BOBARTIA* HEATH

Ajuga ophrydis	r–o
Aspalathus eriophylla	r
A. setacea	r
Bobartia burchellii	a
Buchenroedera multiflora	l
Dierama pendulum	o
Erica cerinthoides	o
Festuca costata	a
F. scabra	r–o
Gladiolus maculatus	r
Gladiolus sp. indesc. (aff. *tristis*)	o–f
Koeleria capensis	f
Osteospermum junceum	o
Poa binata	c
Rhyticarpus difformis	o–f
Scabiosa anthemifolia	f
Senecio oxyriaefolius	o–f
S. tropaeolifolius	f
Themeda triandra	c
Thesium fruticosum	o

Clutia affinis heath has little in common with the other heath types. Considered from the point of view of classification, it probably is to be regarded as belonging to a separate alliance. *Polygonum undulatum*, *Tephrosia grandiflora*, *Indigofera stricta*, *Digitaria macroglossa* and *Osteospermum grandidentatum* are characteristic. This type also often contains *Selago corymbosa*, *Tephrosia capensis* and other aggressive species.

The flora of the gravel pit.

At the lower end of the Reserve, near the Howisons Poort road, an old ironstone gravel pit was formerly utilised for roadmetal, before the present National Road was built. When this practice was discontinued is not known, but the pit is unlikely to have been used since declaration of the Reserve, possible for longer. Some gully erosion of the bare subsoil has occurred, but colonisation by the heath is in progress. A list of the species seen in 1950 is given in Table XII.

The two most abundant species were *Restio triticeus* and *Pentaschistis curvifolia*. It therefore seems likely that grass heath with a large number of woody species would become established on bare rock rubble, at an early stage—significant for any theory of plant succession on the Reserve. Ruderal species are relatively scarce, but *Elytropappus*, *Selago*, *Haplocarpha lyrata*, *Rhynchelytrum* and *Pinus* fall into this category. At this stage, the total cover averages not more than 10%, and the cover per square metre varies from nil to 30%.

TABLE XII

SPECIES GROWING ON EXPOSED SUBSOIL OF GRAVEL PIT

Acalypha peduncularis	r	*Haplocarpha lyrata* (mostly in gully)	l
Agathosma peglerae	o	*Helichrysum anomalum*	o
Anthospermum aethiopicum	o–f	*Hibiscus aethiopicus*	o
Bobartia indica	o	*Lobelia tomentosa*	f
Centella eriantha	o	*Metalasia muricata*	f
Cliffortia linearifolia	f–a	*Moraea setacea*	r
C. repens	o	*Pentaschistis curvifolia*	f–a
Disparago ericoides	f	*Pinus pinaster*	o
Elytropappus rhinocerotis	o	*Relhania pungens*	f
Eragrostis capensis	o–f	*Restio triticeus*	l.a.–d
E. curvula	o	*Rhynchelytrum setifolium*	l
Erica glumaeflora	r	*Selago corymbosa*	f
Eriosema salignum	o	*Senecio concolor*	l
Euphorbia striata	r	*Struthiola parviflora*	o
Gnidia nodiflora	r	*Tephrosia capensis*	o
G. styphelioides	o		

List possibly not complete

(*b*) **Grassland—temperate grassland formation:** (i) Tall tussock grassland subformation; (ii) Low tussock grassland subformation (Martin and Noel, 1960).

Two types of grassland other than the *Festuca—Bobartia* heath may be recognised. Firstly, in the heath-dominated areas, a grass-shrub mosaic or "grass heath" occurs, in which *Cymbopogon marginatus* is very prominent. *Festuca costata* is rare, but *Elyonurus argenteus*, *Themeda triandra*, *Eragrostis curvula*, *Brachiaria arrecta*, *Tristachya hispida*, *Alloteropsis semialata*, *Aristida galpinii* and *Andropogon appendiculatus* are typical.

These areas are often only a few yards in diameter and appear to be natural. It has not been shown however whether the mosaic is stable or undergoes a cyclic succession.

TABLE XIII
FLORA OF TALL TUSSOCK GRASSLAND

Gramineae	
Alloteropsis semialata	c
Andropogon appendiculatus	c
A. filifolius	r
Aristida galpinii	l
Cymbopogon marginatus	l
Elyonurus argenteus	l–c
Eragrostis capensis	f–c
E. curvula	o–f
Eulalia villosa	o–f
Festuca costata	r–o
F. scabra	r
Harpechloa falx	f
Panicum ecklonii	o–f
Pentaschistis angustifolia	f–a
P. thunbergii	f–a
Sporobolus centrifugus	o–f
Themeda triandra	a
Tristachya hispida	o
Others	
Argyrolobium harveianum	o
A. stipulaceum	o
Bobartia burchellii	o–f
B. indica	o–f
Helichrysum appendiculatum	f
Indigofera fastigiata	o
Oxalis bifurca	o
O. imbricata var. *violacea*	l.c.
O. punctata	l.c.
Senecio concolor	c
S. coronatus	o
S. isatideus	o
S. othonnaeflorus	c
Zornia bracteata	r–o

The second type of grassland may not be natural. It is associated with signs of probable disturbance. Just above the main area occur a number of Agaves, a depression which may represent an old earth dam now colonised by *Pteridium*, and, near the centre of the area, an apparent hut site, showing signs of digging. *Setaria flabellata* and *Cynodon dactylon* have become common here, both grasses of disturbed and grazed occupation sites. This is the largest area of more or less pure grassland on the Reserve and the only one where *Setaria flabellata* is abundant. *Eragrostis capensis*, *Digitaria macroglossa*, *Heteropogon contortus*, *Ehrhardta calycina*, *Sporobolus capensis*, *Andropogon appendiculatus* and *Tristachya hispida* are other common grasses. *Tephrosia capensis*, *Gerbera piloselloides* and *Oxalis bifurca* are frequent. The community appears to merge into the mixed dwarf shrub heath and *Pteridium*, which are probably invading it, but the vegetation is evidently fairly stable, as the species list of six analysis circles in this area, quoted by Scott, Norval and Liebenberg, 1933, include most of these species. A few small patches are dominated by *Digitaria macroglossa*, forming a savannah grassland, between 4 and 5 ft. tall at flowering. These may be natural and are a tall tussock type, but as all are close to or included in the disturbed area they are provisionally described with the low tussock grassland.

Table III appears to show that, whereas the tall tussock grassland is pedologically more like the heath, the low tussock type has nitrifying power and pH intermediate between the heath and the woodland, yet low or very low soil organic content, as measured by loss on ignition, while the water content, both shortly after rain had fallen and some weeks later, was lower than that of the tall tussock type (text fig. 8). These data are too few to draw any firm conclusions, but do suggest the likelihood of some pedological site distinction, rather than a purely fortuitous floristic one.

(*c*) **Scrub and forest.** Temperate evergreen forest formation, temperate rainforest subformation: *Olea capensis—Podocarpus latifolius* alliance and temperate rainforest seral transition scrub.

(i) *Structure and composition of scrub and forest.* The scrub and forest on the Nature Reserve are confined mainly to three areas, the largest of which is to the south and east of Dassie Krantz. The second area lies near the lower end of the Reserve in the Featherstones Kloof catchment, and the third and smallest lies overlooking the Howisons Poort road in a small area of perched water table. Small patches also lie along the lower part of the stream draining to the Howisons Poort catchment.

The scrub and forest have many species in common, though some are much more frequent in scrub, for example *Grewia occidentalis* and *Carissa bispinosa;* and others are confined to forest, e.g. *Harpephyllum caffrum.* The difference is mainly one of structure—density and height being the differentiating features. South African ecologists often distinguish "scrub", "bush" and "forest", but the points where "bush" grades into scrub at one end and forest at the other are clearly arbitrary (Phots. 11 and 12).

Scott, Norval and Liebenberg give the following definitions; evergreen scrub—mostly broad-leaved species, gnarled, stunted and liana-bound, and thorny, 8—25 ft. Evergreen bush—mostly broad-leaved, clean-boled trees, 25—40 ft. in height, not gnarled or stunted, with a fair number of lianes. Evergreen forest—mostly broad-leaved trees with heavy canopy, clean-boled, greater than 40 ft. in height, not many lianes or spiny types. Liebenberg (1933) on the other hand, recognised only scrub and bush. "Bush may reach 25—60 ft., has more even canopy, more lianes, fewer armed shrubs, and more mesophytic leaf forms. Dominance does not occur in either scrub or bush canopy."

The distinction is particularly difficult to make in the present instance, as vegetation recognisable as really "high forest" is absent. It is therefore preferable to apply some simple criterion, and in the present instance only two structural types are recognised—"scrub", a low-growing, non-stratified vegetation without marked undergrowth, and "low forest" (or woodland) in which two or three layers are present—herbaceous, shrub layer and canopy—irrespective of species composition, presence of single-stemmed or coppiced growth, frequency of lianes and spiny species, height or any other criteria (though, obviously, there will be some correlations). The one-layered scrub is confined in the main to a small strip near the top of the ridge from just west of Dassie Krantz to the eastern end of the Reserve. Small areas within the woodland also conform to this type. Webb (1959) proposed a new classification of rainforests in Australia, the value of which for South African forest would be worth exploring; further consideration is given to this in the Discussion. According to this classification, the Albany kloof forests would be "simple notophyll vine forests" and "microphyll vine woodlands".

Scott, Norval and Liebenberg (1933, unpub.) made a number of line transects in the two larger areas of woodland and scrub. The transects list all trees and shrubs touching or projecting over the line, but unfortunately, do not give diameter or height of the individual trees. The picture is confused by the fact that few of the transects are confined to a single vegetation type. It is stated that particular transects were "bush merging into forest" and so on. The results for 18 transects are grouped here under the headings "mainly scrub" (7 transects), "mainly bush" (7 transects) and "mainly forest" (4 transects), following the divisions adopted by the authors (Table XIV).

TABLE XIV

LIST OF SPECIES PRESENT IN TRANSECTS OF SCOTT, NORVAL & LIEBENBERG, 1933

Species	Totals			Armed	Scandent	Raunkiaer Leaf Class (C)= compound
	mainly "Scrub"	mainly "Bush"	mainly "Forest"			
Allophylus decipiens	2	—	—			(C)mic
Apodytes dimidiata	13	32	36			mic
Asparagus sp.	2	2	1	*	*	lepto
Burchellia bubalina	11	42	6			meso
Calodendron capensis	1	2	—			meso
Canthium ciliatum	4	2	—	*		mic
C. mundianum	4	9	—	*		mic
C. ventosum	—	2	1			mic-meso
Carissa bispinosa	4	2	2	*		mic
Cassine capensis	1	9	1			meso
Cassinopsis ilicifolia	2	7	1	*		mic
Clausena inaequalis	5	6	—			(C)mic
Clutia affinis	—	3	—			n-mic
Cotyledon velutina	8	—	—			meso
Curtisia dentata	6	34	18			meso
Cussonia spicata	1	15	6			(C)meso
Dovyalis rhamnoides	3	7	9	*		mic
Euclea macrophylla	7	—	—			mic-meso
E. ? lanceolata	17	—	—			mic
Eugenia zeyheri	—	3	28			mic
Fagara capensis	5	1	1	*		(C)mic
Gardenia neuberia	14	1	—	?*	?*	mic
G. thunbergii	—	14	—	?*		meso
Grewia occidentalis	14	1	—			mic
"*Gymnosporia buxifolia*"	74	—	—	*		mic-meso

Species	Totals			Armed	Scandent	Raunkiaer Leaf Class (C) = compound
	mainly "Scrub"	mainly "Bush"	mainly "Forest"			
Halleria lucida	6	15	1			meso
Harpephyllum caffrum	—	—	6			(C)meso
Heteromorpha arborescens	5	1	—			(C)mic
Hippobromus pauciflora	6	12	—			(C)mic
Ilex mitis	—	1	—			meso
Maerua racemulosa	6	—	22			mic
Maytenus nemorosus	36	40	21	*		meso
M. peduncularis	1	5	13			meso
Ochna arborea	—	2	6			mic
Olea capensis s.sp. *capensis*	3	3	15			meso
Pavetta lanceolata	—	—	4			mic-meso
Pittosporum viridiflorum	—	2	5			meso
Pleomele hookeriana	—	1	—			macro
Plumbago capensis	1	—	—		?	mic
Podocarpus falcatus	—	—	1			n-mic
P. latifolius	1	1	7			mic
Pterocelastrus tricuspidatus	—	—	5			mic-meso
Rapanea melanophloeos	22	45	6			meso
Rhoicissus capensis	1	—	—		*	meso
R. cuneifolia	6	61	5		*	(C)mic
Rhus legati	4	12	9			(C)meso
Royena lucida	—	24	6			mic
R. lycioides	13	—	—			mic
R. pubescens	2	—	—			mic
R. villosa	—	—	1		*	meso
Scolopia mundii	4	1	1	*		meso
Scutia indica	69	45	9	*	*	mic
Secamone alpini	3	3	3		*	mic
Senecio deltoideus	5	—	—		*	mic
Sideroxylon inerme	6	—	—			meso
Trimeria trinervis	—	6	2			mic-meso
Vepris undulata	2	1	—			(C)meso
Unidentified (varia)	1	1	2			—
Total	403	420	259			
Total length of transect (100 ft. units)	700 ft.	700 ft.	400 ft.			
No. of individuals/unit length	0·58	0·60	0·65			
No. of species recorded	43	40	35			
No. of armed individuals	221	116	46			
Percentage of armed individuals	54·8	27·6	17·8			
No. of scandent individuals	86	56	19			
Percentage of scandent individuals	21·5	13·3	7·4			

It is clear that, whereas the distinction between scrub and the others is quite recognisable, many of the species differences between "bush" and "forest" appear to be quite fortuitous; possibly a more selective placing of the transects would have brought out more real differences between the types. Certain trends are apparent, however; the greater abundance of *Podocarpus* spp., *Apodytes* and *Olea*, and the reduced abundance of *Scutia* in forest and the replacement of "*Gymnosporia buxifolia*" by *Maytenus nemorosus* and *M. peduncularis. Cotyledon velutina*, *Plumbago capensis* and *Euclea lanceolata* appear to be confined to scrub. The decline of spiny species in forest is quite clear, but the decline in scandent species in both bush and forest is not altogether consistent, either with Liebenberg's definition or my own experience, though Scott, Norval and Liebenberg include a decline in the numbers of lianes in their definition of forest. The data may be atypical in this respect. Certain common lianoid species, such as *Clematis brachiata* ,have been missed, and the abundance of *Rhoicissus* spp. and climbing *Senecio* spp. seems remarkably low.

With the above criticism kept in mind, the data may be compared with those quoted by Seagrief (1950), and by Story (1951) for Albany, and by Story (1953) for scrub and forest types at Keiskamma Hoek. The percentage of spiny species in the Nature Reserve scrub appears fully as great as that quoted for the most arid and stunted scrub type of the Keiskamma Hoek basin (Fort Cox scrub), despite the absence from the list of several spiny shrubs, e.g. *Acacia karroo*, *Azima tetracantha* (both present in the scrub of the Reserve, though uncommon). Certain other characteristic species of the Fort Cox scrub are absent or rare, e.g. *Jasminum multipartitum*, *Randia rudis* and *Olea africana*. It is at first surprising that communities in climatically distinct conditions show such close floristic and physiognomic resemblances, Fort Cox scrub (climatic data of Story, 1953) being drier, with a more definite summer rainfall, less liable to mists and receiving higher temperatures than Grahamstown, (climatic data of Dyer, 1937), but this ubiquity or wide climatic tolerance appears to be a characteristic of many scrub species.

The aggregate "low forest" vegetation may be compared with Story's "Zanyokwe bush" and "Dry" and "Moist" forests as regards degree of spininess. In regard to species composition, they compare most closely with the moist forest. Thus, *Apodytes dimidiata*, *Curtisia dentata*, *Burchellia bubalina*, *Calodendron capensis*, *Halleria lucida*, *Ilex mitis*, *Ochna arborea* and *Podocarpus* spp. all appear to be most typical of moist forest at Keiskamma Hoek, though not entirely absent from the drier types.

Undergrowth in scrub is absent or confined to open spaces between the shrubs. *Setaria lindenbergiana*, *Plectranthus thunbergii*, *Crassula cultrata*, *Melica racemosa*, *Sporobolus pyramidalis*, *Petamenes aethiopicus*, *Pandiaka* *leptostachya*, *Silene capensis*, *Lepidium africanum*, *Pellaea viridis* and *Delosperma* spp. are characteristic.

Once a canopy is formed, a typical forest undergrowth, quite species-rich though scattered, develops, consisting of the following:—

TABLE XV

FLORA OF FOREST UNDERGROWTH

Shrubs (3—15 ft.) and small climbers	
Allophylus decipiens	o
Asparagus asparagoides	o
A. macowani	o–f
A. plumosus	o–f
Burchellia bubalina	o
Canthium ciliatum	o–f
C. mundianum	o
Carissa bispinosa	o
Cassine tetragona	r
Cassinopsis ilicifolia	o–f
Dovyalis rhamnoides	o–f
Gardenia neuberia	r
Halleria lucida	o–f
Hippobromus pauciflora	f
Maerua racemulosa	o–f
Ochna arborea	o
Osyridicarpos capensis	o–f
Pavetta lanceolata	o
Pavonia meyeri	r
Pleomele hookeriana	l.c.
Rhoiacarpos capensis	o–f
Rhoicissus rhomboidea	f
Royena pubescens	o–f
R. villosa	r
Herbs	
Acalypha ecklonii	r
Adenocline acuta	c–l.a.
Argyrolobium tomentosum	o
Australina acuminata	r
Brownleea coerulea	o
Cardamine africana	o
Ceratiosicyos ecklonii (climber)	o
Cyperus albostriatus	f
Dietes vegeta	l
Euphorbia kraussiana	o–f
Galopina circaeoides	f–c
Habenaria arenaria	l
Herbs (cont.)	
Pe. reflexa (epiphyte)	f
Plectranthus ciliatus	c–a
Pl. hirtus	o–f
Pl. laxiflorus	o–f
Pl. thunbergii	o
Senecio quinquelobus (climber)	r
Sida triloba	o
Solanum nigrum	o
Stenoglottis fimbriata	o
Stipa dregeana	r
Streptocarpus rexii	f–c
Vicia sativa	r
Zantedeschia aethiopica	r
Pteridophyta	
Asplenium aethiopicum	c
A. erectum	o–f
A. lunulatum	o–f
A. rutaefolium	c
A. splendens	o–f
Blechnum capense	o
B. punctulatum	l.c.
Dryopteris inaequalis	o
D. pentheri	o–f
Hypolepis sparsisora	r
Lycopodium gnidioides	r
Pellaea viridis var. *macrophylla*	f
Pleopeltis lanceolata (epiphyte)	o
Polystichum adiantiforme	l.c.
Pteris dentata	o
Bryophyta	
Aerobryopsis capensis	
Eulejeunia isomorpha	
Fissidens glaucescens	
F. cf. pycnophyllus (sterile)	

H. falcicornis	r	*Leptodon smithii*
Hypoëstes aristata	l.c.	*Lophocolea bidentata*
H. verticillaris	c–l.a.	*Macromitrium tenue*
Lapeyrousia cruenta	f	*Madotheca capensis*
Leonotis dubia	r	*Metzgeria* sp.
Lithospermum officinale	r	*Neckera valentiniana*
Myosotis intermedia	l.f.	*Papillaria africana*
Oplismenus hirtellus	f	*Pleuropus sericeus*
Panicum deustum	f	*Porothamnium natalense*
P. maximum	o	*Radula capensis*
Peperomia retusa (epiphyte)	f	*Rhodobryum roseum*

Through this woodland a number of permanent tracks have been made. Since 1954, some of them have been bordered and partially paved with rocks from the forest floor. The influence of this added source of disturbance has not been investigated. The following list refers to the species known to occur along tracks prior to 1954.

Table XVI

FLORA OF BUSH TRACKS (NEAR DASSIE KRANTZ)

Abutilon mollissimum
*Acalypha ecklonii**
Adenocline acuta
Berkheya carduoides
Carpobrotus edulis (R)
Conyza pinnata
C. ulmifolia
Cotula heterocarpa (R)
Cynodon dactylon (R)
Danthonia curva
Eragrostis sp.
Euphorbia kraussiana
Galopina circaeoides
Helichrysum anomalum
H. foetidum
Helictotrichum turgidulum
Hypoëstes verticillaris
Hypoxis obliqua
*Lapeyrousia cruenta**
*Leidesia obtusa**
Lepidium africanum (R)
Panicum maximum
Pelargonium alchemilloides (R)
*Plectranthus ciliatus**
P. thunbergii
Poa aff. *trivailis*
Ranunculus multifidus
Senecio pterophorus (R)
Silene capensis
Solanum nigrum (R)
Sporobolus capensis (R)
S. fourcadei
*Streptocarpus rexii**
*Wahlenbergia oppositifolia**
W. procumbens (R)
W. stellarioides (R)
Vulpia bromoides (R)

* Occurring in denser shade.
(R) — Ruderal and semi-ruderal species characteristic of disturbed ground.

Several of the species are natural constituents of forest undergrowth (e.g. *Streptocarpus*, *Lapeyrousia*, *Plectranthus* etc.), but a noticeable feature is the occurrence of many species otherwise quite absent or unimportant in the composition of forest undergrowth, including a number of grasses. These

PHOT. 13.—Clearing in woodland being colonised by *Canthium mundianum.*

PHOT. 14.—Effect of cattle grazing under woodland canopy—grazed out area under "Gymnosporia buxifolia". Ground flora includes only ***Solanum aculeatum,*** scattered ***Hypoëstes verticillaris*** and occasional seedlings of tree, ***Fagara capensis.***

PLATE VII

are mostly in the more highly lit (e.g. scrub) areas; only *Panicum* spp. penetrate shade. The remainder are mostly pioneers of lithosere, e.g. *Hypoëstes*, *Helichrysum foetidum*, *Adenocline acuta*. *Acalypha ecklonii* and *Wahlenbergia oppositifolia* seem to form a special component of forest paths, being found only adjacent to these limited areas.

The ruderal component, likewise, does not penetrate into deep shade, where the paths are almost devoid of flora.

The bryophytic flora was not completely recorded, but includes *Hypnum cupressiforme*, *Pleuropus sericeus*, *Mnium rostratum* and *Tortula pilifera*, *Mnium* being typical of moist conditions.

(ii) *Small clearings in the woodland.* These glades are a very characteristic feature of level ground within the forested area. They vary from about 5 to 30 yards in width, are linked together by a series of paths, and are places where cattle congregate. They are grass-clad, with species such as *Poa c.f. trivialis*, *Sporobolus capensis*, *Eragrostis plana* and *Cynodon dactylon* making up most of the cover. The typical clearing consists of a turf of these grasses, in which many ruderals and other species occur. Saplings of forest species are common at the edges, especially *Rapanea*, *Canthium* sp., *Burchellia bubalina*, *Eugenia* and *Royena pallens*. These are mostly natural precursors of scrub growth, (phot. 13), but as long as cattle continue to utilise the clearings (and it is noticeable how they do seem to choose particular spots where they congregate year after year) complete colonisation by trees is not likely. This shows that even with low average grazing intensity, heavy local overgrazing can still occur.

Locally, completely bare areas may develop (phot. 15), usually showing deep hoofmarks and dung. They are probably due to a combination of several factors, mostly drought and cattle trampling, and they are colonised by ruderals and xerophytic mosses. The three mosses *Triquetrella tristichia*, *Tortula pilifera* and *Hyophila zeyheri* form mats between grasses and so act as pioneers in a subsere, as is seen from the ease with which seedlings of forest species develop.

These clearings have existed for many years, and their origin is not easy to trace. Possibly they are the result of gradual enclosure of small areas of grassland or former heath by scrub. In favour of this view is the seeming youthfulness of most of the surrounding forest, while a soil profile dug in one of these clearings contained hard clay at c. 1 ft. depth in a reddish sandy soil. This is quite distinct from the normal profile of forest, and indicates considerable, and longstanding differences in pedogenesis in the level clearings and the wooded slopes. On the other hand, felling or natural death of trees has clearly been involved too, for in some clearings the decayed remains of one or more prostrate trunks may be seen.

In the woodland with cover still intact, cattle sometimes make their way and cause a removal of undergrowth beneath the canopy (phot. 14). Small

PHOT. 15.—Effect of cattle grazing in woodland clearing. Bare soil with numerous annual plants and xeric mosses.

PHOT. 16.—Over-mature tree of *Oldenburgia*. The more or less horizontal strata of Witteberg break off along joint planes at outcrop, gradually tip forward as boulders loosen, and finally slide down slope. The *Oldenburgia* thus also tips forward. The lower part of stem is often horizontal. Boulders slide down on it from above and tree finally overbalances and falls.

PLATE VIII

shrubs and the natural growth of *Plectranthus* and *Hypoëstes* disappear under grazing, and are replaced by herbaceous lianes, *Panicum deustum* and a few other shade-enduring grasses. *Panicum deustum* grows in quite deep shade and seems an indicator of grazing in scrub and forest. If now a large tree were to die and fall over, the space so opened would be colonised by grasses such as *Cynodon*, and ruderals. While one may visualise clearings originating in this way, a soil profile more reminiscent of forest would be expected.

TABLE XVII

FLORA OF THE BUSH CLEARINGS

Abutilon mollissimum	o
Achyranthes aspera	o–f
Alchemilla capensis	o
Anagallis arvensis	o
Anthospermum lanceolatum	o–f
Aristea ecklonii	o
Berkheya carduoides	l.a.
Briza maxima	r–o
Bulbostylis humilis	o
Burchellia bubalina (young)	r
Canthium sp.	l.c.
Carpobrotus edulis	l.c.
Centella eriantha	l.a.
Clematis brachiata	o
Cliffortia linearifolia	o
Clutia affinis	l.a.
Crassula campestris	o
C. lineolata	l.a.
Cynodon dactylon	a
Danthonia curva	r
Dietes vegeta	r–o
Eragrostis capensis	c
E. curvula	c
E. obtusa	o
Euphorbia kraussiana	o–f
Falkia repens	o–f
Galenia pubescens	l.c.
Galopina circaeoides	f
Haplocarpha lyrata	f
Helichrysum cymosum	f
H. foetidum	c
H. nudifolium	f
H. odoratissimum	l.a.
H. petiolatum	o
Helictotrichum turgidulum	o–f
Nidorella auriculata	l.c.
Oxalis bifurca	o–f
Pandiaka leptostachya	f
Panicum deustum	o
P. maximum	o
Pelargonium alchemilloides	f
Plectranthus ciliatus	o
Pl. thunbergii	o
Poa aff. *trivialis*	o
Polycarena cf. *bracteata*	o
Polygonum undulatum	l
Ranunculus multifidus	l.a.
Rapanea melanophloeos	o
Rhoicissus dimidiata	o
Rhus legati	o
Rhynchosia caribaea	f
Royena pubescens	o
Rubus pinnatus	f–c
Schoenoxiphium sparteum	f
Selago corymbosa	f–a
Senecio concolor	f–a
S. deltoideus	o
S. pterophorus	l.a.
Setaria flabellata	f
Sida triloba	r–o
Sisymbrium capense	l
Solanum sodomaeum	o
Sporobolus capensis	c
Sutera cordata	f
Teucrium capense	f
Tolpis capensis	o–f
Trifolium burchellianum	l.a.
Venidium decurrens	l.c.
Vulpia bromoides	o
Wahlenbergia procumbens	f
Pteridophyta	

FLORA OF THE BUSH CLEARINGS *cont.*

Hermannia hyssopifolia	o	*Asplenium platyneuron*	r
Hibiscus trionum	o	*Mohria caffrorum*	f
Hypochaeris radicata	c	*Pellaea viridis*	f
Hypoëstes verticillaris	l.c.	Bryophyta and Lichens	
Hypoxis obliqua	f	*Bryum truncorum*	
Kyllinga erecta	o–f	*Campylopus* cf. *introflexus*	
Leonotis leonurus	o	*Hyophila zeyheri*	
Lepidium africanum	f	*Hypnum cupressiforme*	
Lobelia erinus	o	*Tortula pilifera*	
L. scabra	o–f	*Triquetrella tristichia*	
Lycium ferocissimum	r	*Cladonia floerkeana*	

(iii) *Ecotones between the woodland and other communities.* Tangles of *Rubus pinnatus*, *Helichrysum petiolatum* and others often occur at the edge of forest. However, the margin between quite tall woodland, 25 to 40 ft. high, and such tangles is often sharp, suggesting possibly some factor which has arrested forest advance, or removed scrub elements from the margin. Such sharp ecotones may be the result of fire, or small scale timber-getting, e.g. for firewood or fence posts. Ring-barking by small rodents e.g. Vlei rats (*Otomys* spp.) has also been advanced as a reason for sharp forest-heath or grassland ecotones, but I have not observed any obvious cases of this in the Reserve, although Vlei rats are common.

Round the edges of the woodland small consocies of pioneer forest species clearly show that the woodland is capable of invading other communities if undisturbed. The two chief consocies are of *Rapanea melanophloeos* and *Canthium mundianum* (phot. 13), while *Tarchonanthus camphoratus* sometimes occurs as solitary trees on the edge of tangles. Solitary small trees of *Cussonia spicata* and *Podocarpus latifolius* may also occur, and small plants of *Burchellia*, *Halleria* and species of *Rhus* have already been shown to be occasional in undisturbed heath. Thus there is evidence that forest and scrub species are able at the present day to invade heath and grassland. Photographs of the eastern slopes of Dassie Krantz taken during the 1930's and in 1956 show the advance of the forest margin in this period. Cronwright Schreiner (1930) quotes the lessee of the grazing rights who in 1925 considered that the forest on Dassie Krantz had advanced since his youth, despite the making of paths. Thus the spread of forest is slow but of long standing, and there is no evidence that enclosure of the Reserve alone has caused this.

(5) HYGROPHILOUS COMMUNITIES.

Owing to the uneven topography, varying in slope and aspect, and in influence of the rock (often resulting in impeded drainage and perched water tables) there are many places where small areas of particularly favourable environment occur in heath or grassland. These are usually marked by a greater luxuriance (height and density) of the flora, and by the presence of some of the following species.

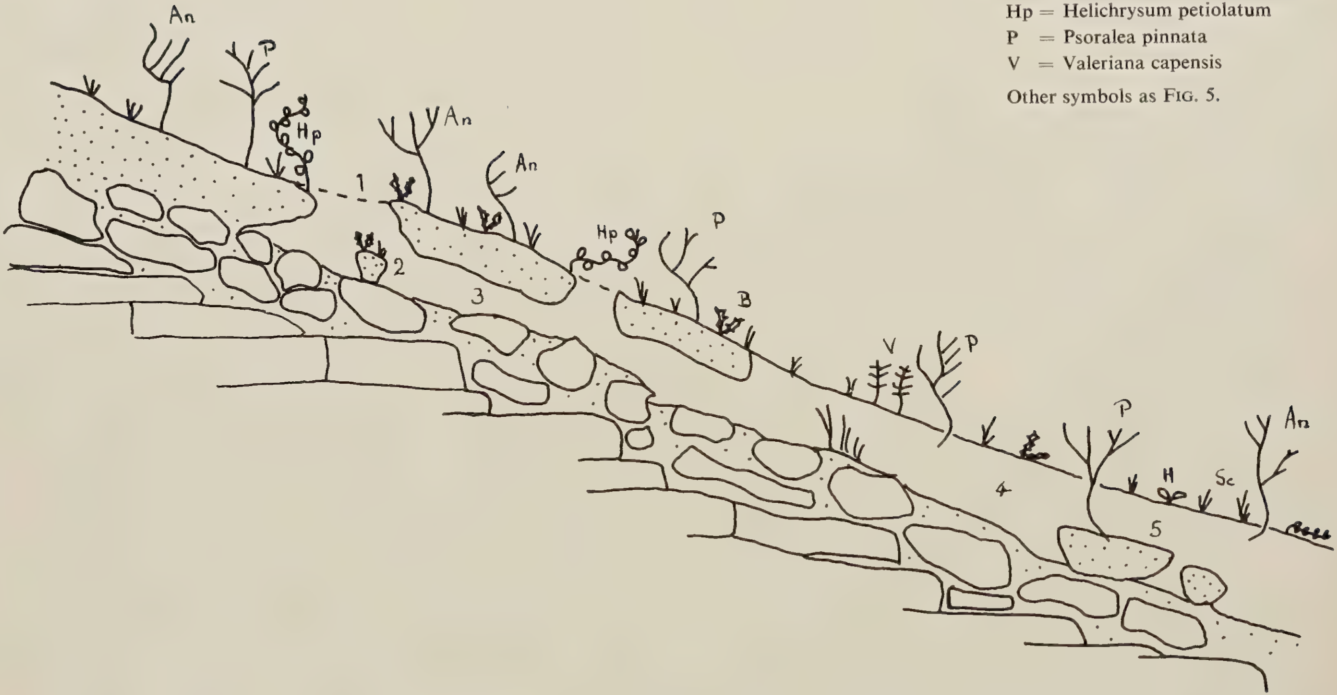
Table XVIII

SPECIES CHARACTERISTIC OF AREAS OF MORE FAVOURABLE WATER BALANCE

Anthospermum aethiopicum
A. lanceolatum
Athanasia punctata
Bulbine altissima
Burchellia bubalina
Chironia melampyrifolia
Cineraria lobata
Clutia affinis
C. hirsuta
Cymbopogon marginatus
Cyphia heterophylla
Diclis reptans
Digitaria diagonalis
Euclea lanceolata
E. undulata
Eucomis undulata
Geranium ornithopodum
"*Gymnosporia angularis*"
Halleria lucida
Hebenstreitia dentata
Hermannia hyssopifolia
H. velutina
Helichrysum petiolatum
Leonotis leonurus
Lobelia hirsuta
Malvastrum scabrosum
Myrsine africana
Nidorella auriculata
Osteospermum grandidentatum
O. herbaceum
Printzia pyrifolia
Psoralea pinnata
P. spicata
Pteridium aquilinum
Rapanea melanophloeos
Rhus dentata
R. eckloniana
R. fastigiata
R. pyroides
Rhynchosia caribaea
Rhynchosia sp.
Rubus pinnatus
Schistostephium flabelliforme
Sutera cordata
S. mollis
Tarchonanthus camphoratus
Tephrosia grandiflora
Valeriana capensis
Venidium decurrens

These species cannot be considered to form a distinct community, as usually only some will be present, but the occurrence of a large number of them is a clear indication of conditions suitable for forest growth.

The species listed above are, in general, characteristic of well-shaded hollows of southerly aspect, and analyses of soils show that the water content is higher than in adjacent heath and grassland. However, there are small areas where distinctly wet conditions arise. Gullies are small channels, usually not more than 2 to 3 ft. deep, cut into the mineral soil, usually to the subsoil or bedrock. These have generally either cut back into more mature vegetation from below, or have resulted from erosion starting from springs higher up. They frequently have steep earth banks with relatively mature soil profile, and have thus arisen by the destruction and modification of the former vegetation. Rafts or islands of soil carried down with vegetation *in situ* may often be seen lying in their

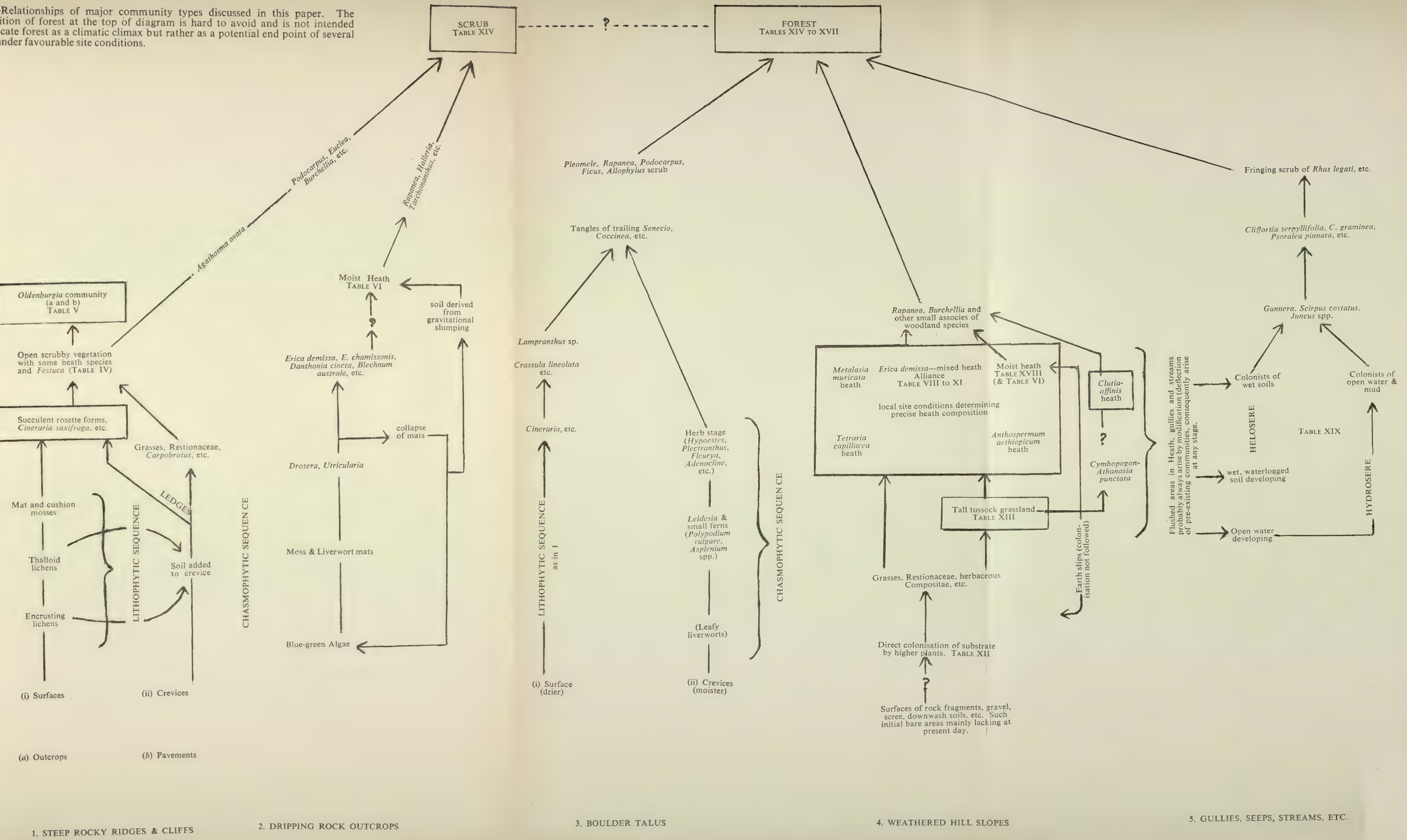


An = Anthospermum aethiopicum
Hp = Helichrysum petiolatum
P = Psoralea pinnata
V = Valeriana capensis

Other symbols as FIG. 5.

TEXT FIG. 6.—Diagram showing cutting back of gully by tunnelling and concentration of hygrophytic shrubs and herbs along gully margin: (1) Sink-hole due to collapse of soil column into tunnel; (2) Vegetation *in situ* on soil column; (3) Tunnel with earth bridge; (4) Open part of gully; (5) Earth rafts in floor of gully with *in situ* vegetation.

TEXT FIG. 7.—Relationships of major community types discussed in this paper. The disposition of forest at the top of diagram is hard to avoid and is not intended to indicate forest as a climatic climax but rather as a potential end point of several seres under favourable site conditions.



SCRUB
TABLE XIV
?
FOREST
TABLES XIV TO XVII
Podocarpus, Euclea, Burchellia, etc.
Agathosma ovata
Rapanea, Halleria, Tarchonanthus, etc.
Oldenburgia community (a and b) TABLE V
Open scrubby vegetation with some heath species and Festuca (TABLE IV)
Succulent rosette forms, Cineraria saxifraga, etc.
Grasses, Restionaceae, Carpobrotus, etc.
LEDGES
Mat and cushion mosses
Thalloid lichens
Encrusting lichens
LITHOPHYTIC SEQUENCE
Soil added to crevice
CHASMOPHYTIC SEQUENCE
(i) Surfaces
(ii) Crevices
(a) Outcrops
(b) Pavements
1. STEEP ROCKY RIDGES & CLIFFS
Moist Heath TABLE VI
?
soil derived from gravitational slumping
Erica demissa, E. chamissonis, Danthonia cincta, Blechnum australe, etc.
collapse of mats
Drosera, Utricularia
Moss & Liverwort mats
Blue-green Algae
2. DRIPPING ROCK OUTCROPS
Pleomele, Rapanea, Podocarpus, Ficus, Allophylus scrub
Tangles of trailing Senecio, Coccinea, etc.
Lampranthus sp.
Crassula lineolata etc.
Cineraria, etc.
LITHOPHYTIC SEQUENCE as in 1
Herb stage (Hypoestes, Plectranthus, Fleurya, Adenocline, etc.)
Leidesia & small ferns (Polypodium vulgare, Asplenium spp.)
(Leafy liverworts)
CHASMOPHYTIC SEQUENCE
(i) Surface (drier)
(ii) Crevices (moister)
3. BOULDER TALUS
Rapanea, Burchellia and other small associes of woodland species
Metalasia muricata heath
Erica demissa—mixed heath Alliance TABLE VIII to XI
Moist heath TABLE XVIII (& TABLE VI)
local site conditions determining precise heath composition
Tetraria capillacea heath
Anthospermum aethiopicum heath
Clutia-affinis heath
?
Cymbopogon-Athanasia punctata
Tall tussock grassland TABLE XIII
Earth slips (colonisation not followed)
Grasses, Restionaceae, herbaceous Compositae, etc.
Direct colonisation of substrate by higher plants. TABLE XII
?
Surfaces of rock fragments, gravel, scree, downwash soils, etc. Such initial bare areas mainly lacking at present day.
4. WEATHERED HILL SLOPES
Fringing scrub of Rhus legati, etc.
Cliffortia serpyllifolia, C. graminea, Psoralea pinnata, etc.
Gunnera, Scirpus costatus, Juncus spp.
Flushed areas in Heath, gullies and streams probably always arise by modification (deflection of pre-existing communities, consequently arise at any stage.
Colonists of wet soils
Colonists of open water & mud
HELOSERE
TABLE XIX
wet, waterlogged soil developing
Open water developing
HYDROSERE
5. GULLIES, SEEPS, STREAMS, ETC.

beds after heavy rains, and observation over a period leaves no doubt that the heads of some of the streams are migrating uphill. Often their upper reaches are marked by the occurrence of earth bridges, the stream running by means of a tunnel for distances of few to many yards. In some such cases, the presence of a stream is only shown by an occasional hole where the roof has caved in. Such phenomena all suggest a fairly recent origin for the gullies (text fig. 6). However, along their courses succession seems often to have been accelerated, as, presumably due to the increased water content of the soil and periodic presence of flowing water, shrub growth commences along their banks. In the upper part of the gullies the stream beds themselves are generally bare, though the banks may be marked by a growth of more hygrophilous shrubs and herbs (Table XVIII). In the lower parts of the course, communities of marsh plants have developed in the small accumulations of alluvial deposits. and a new succession via hygrophilous shrubs to forest seems to have commenced. These stages may be held to represent a helosere or hydrosere, but from the point of view of origin they appear to be superimposed on the general development.

Where flushing by underground water is involved (cases 2*a*, 2*b* and 5, p. 9), the water table is also permanently closer to the surface than average, and the soil often moist to waterlogged for longer than average periods after heavy rains. It is in these areas that earthslips occur if the slope is steep enough. In such places, indicator species from Table XVIII will be present. *Valeriana capensis* and *Athanasia punctata* are particularly indicative. *Carex zuluensis*, *Pelargonium radula* and *P. graveolens*, *Kniphofia uvaria* and *Pennisetum macrourum* may be present. The luxuriance of the vegetation increases. *Erica chamissonis*, though by no means confined to such moist heath, is often common or dominant in well-flushed areas.

In any of these cases a more luxuriant vegetation arises from a less luxuriant type as degradation proceeds. In each case this is due to a local increase in soil moisture content and the vegetation change is scarcely to be regarded as part of a helosere, but as a xerosere deflected from its course by locally superimposed soil conditions.

(6) Community Types of Aquatic and Semi-Aquatic Conditions.

There are two semipermanent streams at the lower end of the Reserve where the drainage lines begin to converge, one joining the Howisons Poort, the other the Featherstones Kloof catchment. The following species are present, groupings dominated by single species over small areas being frequent, as indicated, but the status of such communities has not been investigated.

TABLE XIX

OPEN WATER AND MUD

Anagallis huttonii	
Asterochaete glomerata	
Eleocharis limosa	
Grammatotheca bergiana	
Gunnera perpensa	
Ilysanthes gratioloides	
Juncus capensis	
J. lomatophyllus	l.d.
J. oxycarpus	
Laurentia arabidea	
Limosella aquatica	
Lobelia erinus	
Lysimachia nutans	
Lythrum hyssopifolia	
Phragmites communis	l.d.
Polygonum setulosum	
Scirpus costatus	l.d.
S. ludwigii	

STREAM BANKS AND WET SOILS

Afrachneria ampla	
Carex zuluensis	
Cliffortia graminea	l.d.
C. serpyllifolia	l.d.
Conyza ivaefolia	
Co. pinnata	
Geranium caffrum	
Gnaphalium purpureum	
Gnidia oppositifolia	l.d.
Hermannia hyssopifolia	l.d.
Mariscus congestus	
M. owanii	
M. riparius	
Mentha aquatica	
Nidorella auriculata	
Nidorella undulata	
Ornithogalum comptum	
Pelargonium graveolens	
Pennisetum macrourum	l.d.
Plectranthus laxiflorus	l.d.
Psoralea oligophylla	
P. pinnata	
Pulicaria scabra	
Pycreus lanceus	
Senecio purpureus	
S. rigidus	
Setaria sphacelata	
Valeriana capensis	
Venidium decurrens	
Zantedeschia aethiopica	l.d.

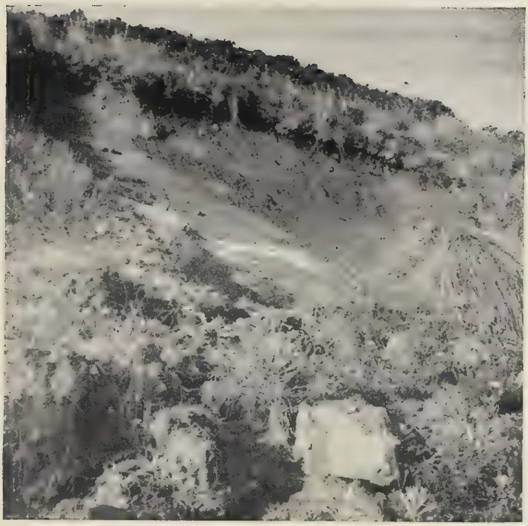
It is doubtful if these streams are truly perennial, except in periods of abnormally wet years. In a dry year they are reduced to a series of muddy stagnant puddles.

DISCUSSION

1. Succession.

In the light of the considerations on pages 9 and 10, the following generalisations may be made and are put diagrammatically in Text fig. 7. In this diagram, the inferred successional status of each of the various community types is indicated.

(*a*) On steep slopes erosion and development proceed concurrently; thus the *Oldenburgia arbuscula* community on rock outcrops is unstable as the result of the collapse of over-mature trees, rock falls and the slumping of soil masses to lower level. Earlier stages of succession are mixed with later ones, and *Oldenburgia* represents a physiographic climax in a state of cyclical fluctua-



PHOT. 17.—Earth slip in heath. This is a site receiving water flowing over bedrock. In wet conditions soil may become temporarily saturated and slide down slope. Forest in background due to perched water table.

PLATE IX

tion (phot. 16). An expression of the same principle is seen in the cyclical development of heath in moss mats on ledges of wet rock, described on pp. 15 and 16. A rather different expression of the same principle is seen in the way that erosion, in cutting back the heads of gullies, establishes locally drier and moister areas in formerly more uniform ones.

(*b*) The land surface is an old one, which has been eroded into its present form very slowly. Early stages of prisere are therefore few in number, cover small areas and are disjunct with each other. Most succession seen is at least in part secondary. The ability of shrubs and grasses to colonise bare areas such as screes and rock rubble shows that lichen and moss stages of the hypothetical prisere are often bypassed. The colonisation of the gravel pit by *Restio*, *Pentaschistis* and shrubs is further evidence of this.

(*c*) A "poly-climax" viewpoint is adopted. The importance of differences in topography and of microtopography is strongly emphasized. Succession has taken different courses in areas of different initial topography, while the concept of the cosere—a patchwork of seres of different origin, proceeding and converging towards a relatively small number of climax types, is the most readily applicable to the mosaic of successional stages seen in each topographical area. Such mosaics occur often in a very small area and may develop at different rates; thus on Witteberg "pavements" on the top of the ridges, with a microtopography of flat rock surfaces and crevices, a long-persisting, slowly developing lichen stage occurs on the surface of the slabs, while a much more rapidly developing grass-heath occurs in the crevices. It is possible that the soil washed into the crevices is derived partly from the lichened surfaces and that ultimately the shrubs colonise the slabs from the edges. Thus the lichen stage is replaced, not by a new development on the surface, but by a marginal encroachment of a later stage, to which however the lichen stage has contributed (phot.2).

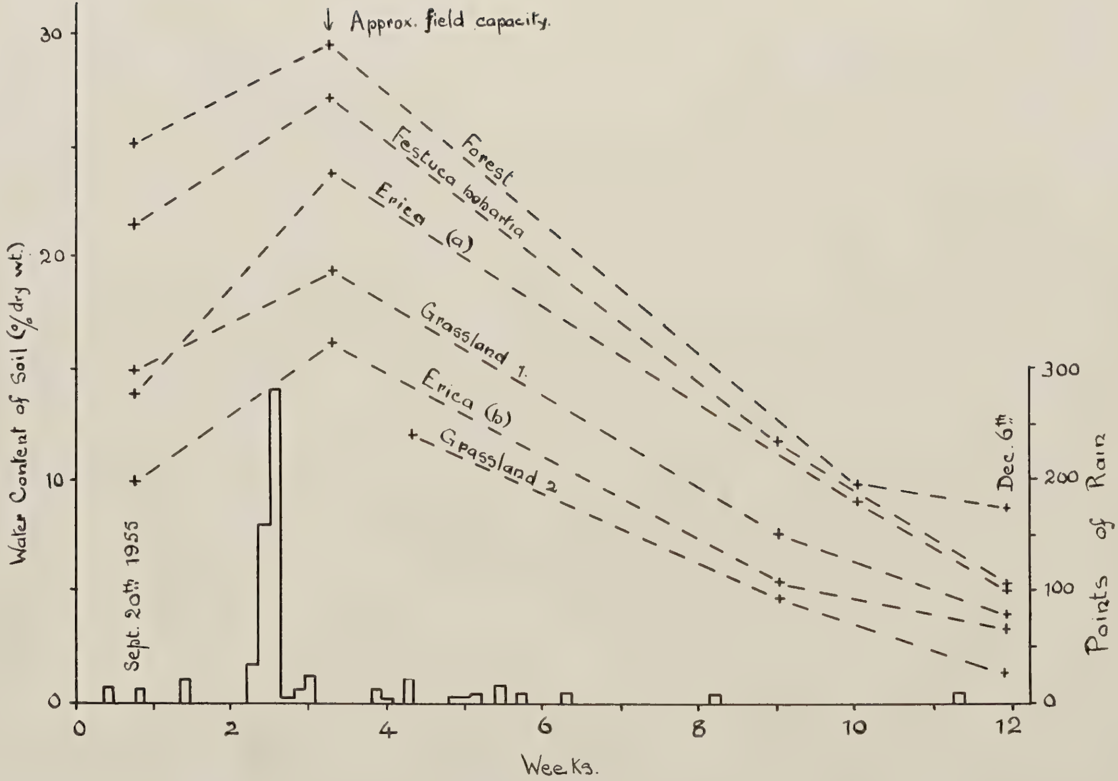
The woodland too is essentially physiographically controlled. Of the three main forest sites on the Reserve, the smallest is on a gentle slope lacking shelter, but apparently with a high water table due to the drainage from above being impeded by a rock barrier. The second area lies along the stream feeding Featherstones Kloof and the tallest woodland in this is simply a narrow strip along the stream. This site owes its existence partly to the higher availability of water, partly to shelter by the steep slope behind it. The smaller foci in which *Rapanea*, *Rhus legati* and other woodland pioneer species are developing are also mainly restricted to these two types of site.

The area to the east of Dassie Krantz is the most difficult to account for, since it appears to be unrelated to special conditions, either of shelter or ground water. It cannot easily be interpreted as cloud forest, for despite its higher altitude, a good deal of heath and grassland exists with the same altitude, and it is doubtful if cloud ever develops in sufficient quantity on the slope to give rise to sufficient precipitation. Liebenberg (1933) reported experiments on this area with vegetation screens, showing a supposed high "induced" rainfall, due to interception by tall plant cover of 62% extra precipitation at 4 ft. and 105·2% at 20 ft., but this in itself would not be sufficient to account for the development of woodland on this section of the slope, rather than elsewhere, even if the interpretations themselves were free of criticism (Fourcade, 1942). The ease with which trees colonise boulder talus and rock faces may form a clue. The soils of the woodland are mainly particularly shallow with a great many boulders at the surface. The slope is above average for the Reserve (up to 40°, phot 11). Only trees appear capable of effectively colonising such terrain, as their root systems are widespread and deep-growing enough to penetrate the talus for a firm anchorage, and obtain water from the inner part of the talus. Judging by the luxuriance of the vegetation on the Dassie Krantz talus, the water content not far below the surface must be high. The conclusion would thus be that trees occupy much of this area only because no other vegetation could colonise it effectively. If this is so, this area of forest is not necessarily the end point of a sere leading through heath, but may be a community climaxing a sere beginning on bare boulder scree, capable however of spreading laterally from this centre into adjacent heath.

Table II shows that the soil organic content (measured as loss on ignition) in forest is twice that of the heath. At the time of sampling (shortly after heavy rain with soil close to field capacity) the water content was also roughly twice that of the heath. The pH is closer to neutrality and the nitrifying power high, indicating higher base status and fertility. Samples from the stream bank community and the Dassie Krantz talus, both potential forest sites, also have some of these properties, suggesting that the forest may not necessarily create these soil conditions, but may invade sites where they already exist, at least in part. Text fig. 8 shows that forest soil, both in wet and dry climatic conditions, possesses a higher water content than heath or grassland soils. The surface soil of forest, none the less, initially loses water rapidly after rain. Probably both transpiration and drainage are rapid, yet as the soil dries out water tends to be conserved, owing partly to the higher humus content, partly to the lower direct evaporation loss, partly to the ability of the trees to exploit deeper levels of the soil for water as the surface layers dry.

2. Life form spectrum and physiognomy.

The Raunkiaer life-form spectrum of the Reserve is interesting. Despite the domination of parts of the area by heath and forest, it is noteworthy that all the phanerophytic classes, even nanophanerophytes, are below the average of



TEXT FIG. 8.—Twelve week survey of water content of surface soil at six sites in five community types, in which time water content fell from near field capacity to near wilting point, illustrating the relatively high rate of loss from forest soil, and the marked overlap between heath and grassland.

the normal spectrum. Epiphytes are not very conspicuous, therophytes would be even less significant if introduced casuals and ruderals were excluded. They form an insignificant part of the natural flora. The spectrum is dominated by chamaephytes, hemicryptophytes and geophytes. The flora of the Reserve is representative of the vegetation of a large part of Central Albany, and there is no reason to think that the addition of another 200 species (representing species typical of this flora but not present in the Reserve) would appreciably alter the composition of the spectrum. Such a spectrum is difficult to match, and resembles most closely the spectra of certain kinds of grassland and steppe.

TABLE XX

LIFE FORM SPECTRA

	MM	M	N	Ch	H	G	HH	Th	E	Pt.Q	No. spp.
Grahamstown Nature Reserve	5·2	8·5	11·7	**18·8**	36·6	11·1	2·0	5·4	1·2	0·9	691
Normal Spectrum	8	18	15	9	26	4	2	13	3	1·0	1000

The term "sclerophyll" has been used (Adamson, 1938) to describe the vegetation of the Western Cape, to which the heaths of Albany are floristically related. The sclerophyll leaf, cartilaginous, xeromorphic, but flat and of moderate size (of microphyll or mesophyll size class) is not however so characteristic of the heaths of Albany. Proteaceae, e.g. *Protea* and *Leucadendron* spp., which make up a large part of the Cape sclerophyll, together with plants of similar habit such as *Gymnosporia laurina*, are not a major part of this vegetation. The dominant nanophyllous and leptophyllous heath species are replaced in succession (in those areas where heath does not itself represent the climax) by the precursors of forest. The forest species are predominantly microphylls and mesophylls but for the most part not strongly sclerophyllous. The term "notophyll" (Webb, 1959) defines the leaf size class which, on Raunkiaer's grouping comprises small mesophylls. To this size group a very large number of the forest species of Albany belong. Of 44 trees and woody lianes entering canopy in forest of the Reserve, I estimate 18 to have microphylls, 22 notophylls, 3 mesophylls (sensu Webb) and 1 macrophyll.

The abundance of the chamaephytes, hemicryptophytes and geophytes in the heath probably reflects in some part the long-standing prevalence of fire in these communities. Du Rietz (1931), in a critical review of the life-form concept, proposed some revision of the chamaephyte concept of Raunkiaer. His classification of shrub life-forms is more penetrating than that of Raunkiaer. It is interesting that two of the categories recognised by him—the dwarf shrub (holoxyle) and half-shrub or suffrutex (hemixyle) are very common on the Reserve. If Du Rietz were to be followed in putting the chamaephyte limit at 0·8 m instead of Raunkiaer's 0·25 m, the greater part of the heath, even many of the dominants, would be classified as chamaephytes. More important than the precise delimitation of the chamaephyte level, is the fact that, among the hemixylic and holoxylic groups the erect aeroxylic (persistent aerial stem, branching near base) and geoxylic (non-persistent aerial stems, branches developing from hypogeal mesocorm stock or lignotuber) types are commonest. Of the aeroxylic type, Du Rietz says "I do not know of a single example of a North European dwarf shrub species regularly belonging to it. On the other hand, this is one of the most common types of dwarf shrub in the heath vegetation of the southern parts of Australia, and probably also in other regions with a similar climate (e.g. the Cape)."; of the geoxylic type "(This) type is about as common as the aeroxylic type (in Australian heath vegetation)". Lignotubers occur also in some true shrubs, e.g. *Protea cynaroides*. Du Rietz' supposition about the Cape is evidently correct, as far east as Albany.

It is the geoxylic type of dwarf shrub (e.g. *Leucadendron salignum* and *Struthiola* spp.) and half shrub (e.g. *Chaetacanthus setiger* and *Indigofera* spp.) which are most abundant on the Reserve and this type which is so well pre-adapted to fire. As the climatic limits of the South African heath (just as in the Australian heath) are approached, so the larger microphanerophytes and nanophanerophytes diminish in numbers, to be replaced by these fire-hardy forms. Finally, grasses and other hemicryptophytes replace the woody life-forms as the climatically favoured types. The winter rainfall of the Cape is both heavy and extremely reliable and fires occur mainly in summer. At Grahamstown both winter and summer rainfall are unreliable and fires frequently occur in winter. Liebenberg's analysis (l.c.) shows the summer rainfall to be more reliable than the winter. Jarrett and Petrie (1929) argued against the view that fire-favoured life-forms represented a direct adaptation to the survival of fire. They pointed out that certain fire-resisting characters are also found in plants of regions not subject to fire. Allowing that some characteristics which enable plants to survive fire may originally have been selected for other functions, I see no reason why this should be supposed of the geoxylic habit. If the geoxylic habit is resistant to fire, then assuming that fire has been a factor in the history of the vegetation of some climatic regions for a very long time, natural selection would favour the spread of those plants in a species having this habit. If life-forms have adaptive significance at all, this must be the mechanism of their evolution. But if fire has not selected this life-form, to what other feature of the climate is it an adaptation?

The manner in which the lower-growing life forms occur in mature heath suggests that only the periodic destruction of this heath enables them to persist at all. One may either argue that the mature heath as seen today is an artefact produced by fire in the past century and a half (the false macchia of Acocks, 1953), or else accept the view that fire has always occurred sooner or later, enabling the persistent geophytes, hemicryptophytes and geoxylic dwarf shrubs and half shrubs to develop fully and to flower. In view of the slowness with which aliens and ruderals have entered the flora, the abundance of the fire-resistant life-forms and the apparent stability of the vegetation types over a period greater than 20 years (the units recognised by the present author appear to have been present in the vegetation studied by Scott and Liebenberg), the former view becomes more difficult to accept than the latter, and I consider that fire should be regarded as a natural factor of this region. The frequency of its occurrence is another matter. In a further paper, the effects of fire on the vegetation of the Grahamstown Nature Reserve will be studied more fully.

SUMMARY

The vegetation of the Grahamstown Nature Reserve consists of heath, grassland, woodland and low forest formations, with very small areas of hygrophytic and helophytic communities. The plant communities are grouped according to successional status and physiographic features of the sites they occupy. At present no attempt is made to classify the communities as associations, as the vegetation of the large area of central Albany, of which the Reserve forms a part, has not been examined in the same detail. However, it is known that many of these groupings do in fact occur throughout the whole semi-mountainous Witteberg region.

The inherent physiographic instability of the area is expressed in soil creep, slumping (solifluction in the widest sense) and gullying, and the vegetation of the more unstable sites is considered in terms of a balance of upgrade and downgrade tendencies resulting in successional cycles.

Nonetheless, the vegetation is essentially stable, despite the steep slope and areas of prisere are few. It is suggested that several seres are involved, corresponding to the physiography of the sites. Evidence indicates that forest does not at present occupy all the sites which are potentially suited to it, but is tending to spread. Similarly, heath tends to invade grassland. Despite this, it is shown that the life-form spectrum of the area is not dominated by phanerophytes, but by chamaephytes, hemicryptophytes and geophytes. It is suggested that in this region, which is climatically marginal to the winter rainfall area in which the Cape heath or sclerophyll reaches its fullest expression, it is the susceptibility of the taller heath species to winter drought and more especially to winter heath fires which has led to the predominance of life-forms which are more fire resistant.

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NOTES ON THE ALOES OF ARABIA WITH DESCRIPTIONS OF SIX NEW SPECIES

J. J. Lavranos

(With Plates X–XVI)

The first botanist to explore parts of Arabia and to collect Aloe there was Forskal who accompanied an expedition which visited the Yemen on instructions of Frederick V., King of Denmark. Forskal began his travels at Lohayya, on the Red Sea coast, late in 1762 and covered a considerable area in the Yemen. He died of a fever on 11 July 1763, in tragic circumstances, and was buried in Yarim on the Yemeni highlands. His work was published posthumously by Carsten Niebuhr in *Flora Aegyptiaco-Arabica*, (1775).

No Aloes were collected in Arabia after Forskal until 1887, when Deflers visited the Yemen and later, in 1890, 1893 and 1894, the Aden hinterland. He described one new species and made reference to others but, like most of his successors, he assigned to "*Aloe vera*" or its varieties, a large number of forms which the present writer has collected and found to be specifically distinct.

Schweinfurth travelled extensively in the Yemen in 1889 and collected many Aloes. He described two new species and two varieties.

Th. Bent visited the Hadhramaut in 1893–4 on an archaeological mission. He was accompanied by Lunt, a gardener from Kew. Three forms of Aloe were collected, of which one was described as *A. luntii* Bak.

Dr. C. Rathjens and Prof. H. von Wissmann carried out the first of their journeys to Southern Arabia in 1927–8 for the purpose of geographical research. Rathjens returned to the Yemen in 1931 in which year von Wissman travelled in the company of Mr. D. van der Meulen to the Hadhramaut. Later that year he explored the areas around Qataba and Dhala alone; he then went back to Sanaa in the Yemen. Rathjens returned to that country in 1934 and once again in 1939, in which year von Wissmann and van der Meulen made their journey overland from Aden to the Hadhramaut. A considerable volume of Aloe material was gathered during these journeys. No new species was based on it and Dr. O. Schwartz, who worked on the collections of Rathjens and von Wissmann, followed Deflers and Schweinfurth in ascribing a large number of specimens to the ubiquitous "*Aloe vera*. var. *officinalis*."

In recent years, and prior to the present author's journeys to Arabia, there have been sporadic gatherings of Aloe, such as those of Mr. D. Vesey-Fitzgerald in Asir (Saudi Arabia), Mr. Ken Guichard, Captain W. J. Waring and Professor Gilliland in the South Arabian Federation and the Hadhramaut, and Col. D. de C. Smiley and Mr. W. M. M. Deacock in the Jebel Akhdhar area of Oman. One new species has been based on these collections, *Aloe gillilandii* described by Dr. G. W. Reynolds.

The present author visited south western Arabia and the Hadhramaut in August 1962 and, again, accompanied by Professor Dr. W. Rauh, in March 1964. Much Aloe material was collected on both journeys and it is on this that the new species here described were founded.

The known distribution of the genus *Aloe* in Arabia thus extends from the high mountains of the Asir, in the north-west, throughout the coastal hills, highlands and mountain ranges, constituting the southern fringe of Arabia, to the alpine folded range of Jebel Akhdhar in the east. The latter locality, which is in the region of latitude 23°N., longitude 58°E., marks the farthest known north and east for the distribution of the genus.

The species of Aloe from Arabia first described by Forskal (*l.c.*) are the following:

1. *A. maculata* Forskal in *Fl. Aeg. Arab.* 73, (1775); Schweinfurth in *Bull. Herb. Boiss.* 2, app. 2, 59 (1894); Baker in *Journ. Linn. Soc.*, 175 (1880), from Lohaja (Lohayya) in the Yemen. The flowers are stated to be yellow, the leaves a foot long, the inflorescence six feet high. No other information is given. Berger queries whether *A. maculata* should be referred to a variety of *A. vera* L. (the correct name of which is *A. barbadensis* Mill.). Schweinfurth (*l.c.*) reduced this species into synonymy under "*A. vera* var. *officinalis*", while Baker (*l.c.*) queries it as a synonym of *A. abyssinica* Lam. In view of the very incomplete description and the total absence of herbarium material *A. maculata* Forsk. should be regarded as a *species non satis cognita* and dropped.

2. *A. officinalis* Forskal, in *Fl. Aeg. Arab.* 73, (1775); Deflers in *Voyage au Yemen*, 211 (1889), in *Esq. Geogr. Bot.* (1895); *A. vera* L. var. *officinalis* (Forsk.) Baker, in *Journ. Linn. Soc.* 18, 176 (1880); Schweinfurth in *Bull. Herb. Boiss.* 159 (1894); Berger in *Pfianzenr.* Liliac. Aloin. 229 (1908); O. Schwartz in *Beitr. z. Kenntn. d. Fl. S. W. Arab.* 181 (1934), in *Fl. Trop. Arab.* 350 (1939); Blatter in *Fl. Arab.* 464 (1936). From Wadi Mor near Lohayya (Lohaja) in the Yemen. The flowers are described as red, cylindric-trigonous (tereto-triquetri); the perianth-segments are said to have reflexed apices; the inflorescence is described as "sometimes bifid" and it may hence be assumed to be usually simple; its height is given as two cubits (bicubitalis) i.e. as somewhere between 90 and 110 cm.

Baker (*l.c.*) reduces this taxon to *A. vera* L. var. *officinalis* (Forsk.) Bak.

under which he includes *A. rubescens* D.C. Schweinfurth adopts Baker's view and gives the following localities: Yemen. Badjil (200 m.) No. 531; foot of Gebel Bura near Hille (600 m.) No. 360; near Chalife to the east of Merrana (300 m.) No. 182; at foot of Gebel Melhan near Wolledje (600 m.) No. 658. Schweinfurth describes the flowers as yellowish or orange and the inflorescence as simple or often 3-branched and up to 2 m. high. There appears to be some doubt as to whether Schweinfurth's collections indeed belong to "*A. vera.* var. *officinalis.*" However, until such time as both his and Forskal's localities can be revisited, it is best to include them under that species. Berger, (*l.c.*) follows Schweinfurth in both description and localities but includes Stuhlmann 1125 from Zanzibar. This is an obvious error as neither *A. barbadensis* nor *A. officinalis* are known from Zanzibar. Stuhlmann 1125 may represent *A. massawana* Reynolds, introduced from Eritrea.

Finally, O. Schwartz (*l.c.*) lists various collections made by Delflers, Paulay and von Wissmann in the Yemen, the hinterland of Aden and the Hadhramaut under "*A. vera* var. *officinalis.*"

It is impossible, in the light of our present knowledge of the genus *Aloe* to follow Baker in his classification of this species. *A. barbadensis* Mill. (which is the correct name for "*A. vera* L.") while related to Forskal's plant in several respects, has characteristically ventricose perianths which cannot be described as "terete-triquetrous", and are not at all constricted above the ovary. Schweinfurth moreover, describes the pedicels of *A. officinalis* as 6-8 mm. long, and the anthers and stigma as scarcely exserted, while in *A. barbadensis* the pedicels are shorter and the anthers and stigma exserted by up to 5 mm.

In view of the above differences and of the obscurity surrounding the origin of *A. barbadensis* Mill. (= "*A. vera* L.") the present writer has decided to maintain the specific status of Forskal's plant. The name *A. officinalis* Forsk. is, therefore, upheld.

Berger (*l.c.*) includes *A. rubescens* DC.—*Hist. Pl. Grass.* t. 15 (1799)—under *A. officinalis*. While there may be some resemblance between the two species in habit and form of leaves, *A. rubescens* is depicted as having a rather short, laxly flowered inflorescence and perianths which are campanulate and very prominently stipitate, the stipus tapering into the pedicel. These characters seem to be alien to *A. officinalis* as described both by its author and by Schweinfurth. Southern Arabia was, in the 18th century, a very inaccessible region and the home of De Candolle's species—for which no habitat data are available—may well have been in Africa. *A. rubescens* DC. should be regarded as distinct from *A. officinalis* Forsk.

3. *A. veriegata* Forsk. (*non* L.), in *Fl. Aeg. Arab.* 74 (1875); no locality is given and there is no description of the flowers. Moreover, the epithet was occupied. This species must be dropped.

4. *A. pendens* Forsk., *Fl. Aeg. Arab.* 74 (1775) Baker in *Journ. Linn. Soc.* 18, 181 (1880). Schweinfurth in *Bull. Herb. Boiss.* 2, app. 2, 72 (1894); Engler in *Notizbl. Berl. Bot. Gart.* 5 (1897); Berger in *Bot. Mag.* 7837 (1902); in *Pflanzenr.* Liliac.-Aloin. 272 (1908); Blatter in *Fl. Arab.* 464 (1936); Christensen in *Dansk. Bot. Ark.*, 4, No. 3, 18 (1922); O. Schwartz in *Fl. Trop. Arab.* 350 (1939). The type locality of this species is given as Hadie, in the Southern Yemen mountainland. It was later collected by Schweinfurth at various places on the Western escarpment of the Yemen. A plant collected by H. St. J. Philby at Arif, Asir province, Saudi Arabia (B.M.—No. 46), appears to belong to this species.

5. *A. inermis* Forsk., *Fl. Aeg. Arab.* 74 (1775); Baker in *Journ. Linn. Soc.* 18, 181 (1880); Berger in *Pflanzenr*, Liliac-Aloin. 268 (1908); Blatter in *Fl. Arab.* 463 (1936); O. Schwartz in *Fl. Trop. Arab.*, 351 (1939); Christensen in *Dansk. Bot. Ark* 4 No. 3, 18 (1922); Reynolds in *Journ. S. Afr. Bot.* 24, 173 (1958); *A. luntii* Bak., in *Kew Bull.* 342 (1894), in *Bot. Mag.* t. 7448 (1895). This species was collected at various points in the Southern Yemen, while the form described as *A. luntii* occurs in the Hadhramaut. The present author has also found *A. inermis* growing in considerable numbers in the Wadi Hardaba in the Haushabi and Amiri country of South Western Arabia, the red-flowered form being most frequent while one with yellow flowers was collected at the foot of the Khureba Pass. The species was, furthermore, found by Mr. Bally and Dr. Reynolds at Las Anod, Taleh and Halin in Northern Somalia—(formerly Somaliland Protectorate.)

6. *A. vacillans.* Forsk, *Fl. Aeg. Arab.* 74 (1775); Schweinfurth (errore *vaccillans*) in *Bull. Herb. Boiss.*, 2, App. 2, 65 et 109 (1894); Berger in *Pflanzenr.*, Liliac-Aloin., 227, (1908); O. Schwartz, *Fl. Trop. Arab*, 350 (1939); Blatter in *Fl. Arab.* 463, (1936); Christensen in *Dansk. Bot. Ark.*, 4, No. 3, 18 (1922). The type locality is given as Kurma, in the mountains of the Southern Yemeni escarpment. Schweinfurth collected this species at various points along the Yemeni escarpment, while von Wissmann gathered it near Izz, in the interior of the Yemen.

In his various papers covering his journeys, Deflers refers repeatedly to *Aloe* but attributes most of the plants which he observed to "*A. vera*". He described only one new species, *A. tomentosa* Defl., in *Voyage au Yemen* 211 (1889), from the slopes of the Jebel Hadhur Nabi Shwaib, West of Sana'a in the Yemen, a mountainous area enjoying a high rainfall; *vide* also Berger, *Pflanzenr.*, 232 (1908) Blatter, *Fl. Arab*, 464 (1936); O. Schwartz, *Fl. Trop. Arab.* 350 (1939) and Reynolds, *Journ. S.A. Bot.* 24, 166 and 173 (1958). Deflers describes his species as shrubby (fruticosa) and its inflorescence as many-branched. The plants from Moledera in Northern Somalia ascribed by Dr. Reynolds (*l.c.*) to this species are acaulous and have a 3—4-branched inflorescence. In view of these differences, the present writer wishes to query whether the plants from Somalia do not represent a species distinct from *A. tomentosa* Defl. It is to be hoped that Defler's type locality may be revisited, when this problem might be solved. Vesey-Fitzgerald No. 16076/6 from Suda in Asir (Saudi Arabia), now at the British Museum (Natural History), may belong to *A. tomentosa*.

Schweinfurth described two new species plus two varieties of Aloe from Southern Arabia. Of the two varieties one was raised to specific status by Blatter (*l.c.*), the other had to be referred as a variety under a species other than the one chosen by its author. The Aloes first described by Schweinfurth from Arabia are the following:

1. *A. rubroviolacea* Schweinf, in *Bull. Herb. Boiss*, 2 app., 2, 71 (1894); Engler in *Notizbl. d. Berl. Bot. Gart.* 1, 5 (1897); Hook f. in *Bot. Mag.* t. 7882 (1903); Berger, in *Pflanzener*, Liliac-Aloin. 296 (1908); Blatter in *Fl. Arab.* 464 (1919–36); O. Schwartz in *Fl. Trop. Arab.* 351 (1939). From high altitudes on the Western Escarpment of the Yemen.

2. *A. sabaea* Schweinf. in *Bull. Herb. Boiss.* 2, app. 2, 74 (1894); Berger in *Pflanzenr.*, Liliac-Aloin. 320 (1908); Blatter in *Fl. Arab.* 463 (1936); O. Schwartz in *Fl. Trop. Arab.* 351 (1919). A tree from the foothills of the Yemeni escarpment.

3. *A. menachensis* (Schweinf.) Blatter in *Fl. Arab.-Rec. Bot. Surv. Ind.* 463 (1936); Lavranos in *Journ. S.Afr. Bot.* 30, 2, 83 (1964); *A. percrassa* Schweinf. (non Todaro) var. *menachensis* Schweinf. in *Bull. Herb. Boiss.* 2, app. 2, 64 (1894); *A. trichosantha* Berger var. *menachensis* Schweinf. in *Pflanzenr.*, 38, 232 (1908); O. Schwartz in *Fl. Trop. Arab.* 351, (1939). From the Jebel Haraz on the Western Yemeni escarpment.

4. *A. officinalis* Forsk. var. *angustifolia* (Schweinf.) Lavranos, comb. nov.; *A. vera* L. var. *angustifolia* Schweinf. in *Bull. Herb. Boiss.* 2, app. 2, 62 (1894); Blatter in *Fl. Arab.* 464 (1936); O. Schwartz in *Fl. Trop. Arab.* 350 (1939). From the foothills of the Western Yemeni escarpment. Schweinfurth (*l.c.*) queries whether this might not be merely a variable form; he states that it closely resembles "*A. vera* var. *officinalis*". Since the author, for reasons set out above, considers the latter to be a species in its own right, the var. *angustifolia* must be combined as a variety of *A. officinalis* Forsk. Future research at the type locality may lead to the ultimate rejection of this variety but, in spite of present doubts, it would be inadvisable to do so now.

Only two further species of aloe were described from Arabia, namely *A. gillilandii* Reynolds in *Journ. S.A. Bot.* 28, 4, (1962) and *A. lavranosii* Reynolds in *Journ. S.A. Bot.* 30, (1964).

The first of these species occurs within a limited altitudinal range over wide tracts along the southern escarpment between Taizz in the west and Habban in the east. The other is rare on the Amiri highlands of S.W. Arabia.

The present writer, accompanied in 1962 by Mr. C. Meintjes, and in 1964 by Professor Dr. W. Rauh, investigated the Aloes which grow in south-western Arabia and the Hadhramaut. Every accessible region was visited within the time available and, although the research is by no means complete, our knowledge regarding the Arabian section of Aloe has been considerably enlarged.

It thus appears that there are at least 20 species and varieties of Aloe growing in Arabia. Of these, nine seem to be undescribed, with one possible exception, while the 10 named species and the one named variety are:

1. *A. officinalis* Forskal.
1a. *A. officinalis* Forsk. var. *angustifolia* (Schweinf.) Lavranos.
2. *A. vacillans* Forsk.
3. *A. menachensis* (Schweinf.) Blatter.
4. *A. tomentosa* Defl.
5. *A. inermis* Forsk.
6. *A. pendens* Forsk.
7. *A. rubroviolacea* Schweinf.
8. *A. sabaea* Schweinf.
9. *A. gillilandii* Reynolds.
10. *A. lavranosii* Reynolds.

Of the nine remaining species two are being cultivated in Johannesburg and elsewhere and flowers are awaited before their identity can be ascertained. Of these, the one from near Jidma, 25 miles North of Mukalla in the Hadhramaut, is acaulescent, forms groups of several rosettes and has ensiform, extremely thick leaves up to 60 cm. long and 6—7 cm. broad. The other, from the edge of the Audhali Escarpment in the Aden hinterland, is a solitary plant with a short, procumbent stem and a large rosette which invariably lies on its side; its flowers are said to be yellow.

A third species, not well enough known to permit a diagnosis was, as previously stated, collected at an altitude of approx. 1,000 ft. (300 m.) in the Sumail gap which separates the Jebel Akhdhar from the mountains of the Sharqiya (Col. D. De C. Smiley, s.n. coll. Nov. 1959, in B.M.) This may represent the same species as the material collected at 6,000—8,500 ft. (1,800—2,600 m.) on the Jebel Akhdhar (W. M. M. Deacock No. 19, coll. Jan. 1959, in B.M.)

These plants from the Sumail gap appear to have yellow (or perhaps red) ventricose perianths and, so far as the herbarium material and habitat photographs permit one to say, they are hardly distinguishable from *A. barbadensis* Mill. (= *A. vera* L.). Dr. G. W. Reynolds (*in litt.*) points out that, according to Dioscorides who described the common Drug Aloe in the first century A.D., this plant is found in India and also in Arabia, etc. Dr. Reynolds queries whether the Omani plants might be the same as *A. indica* Royle which was

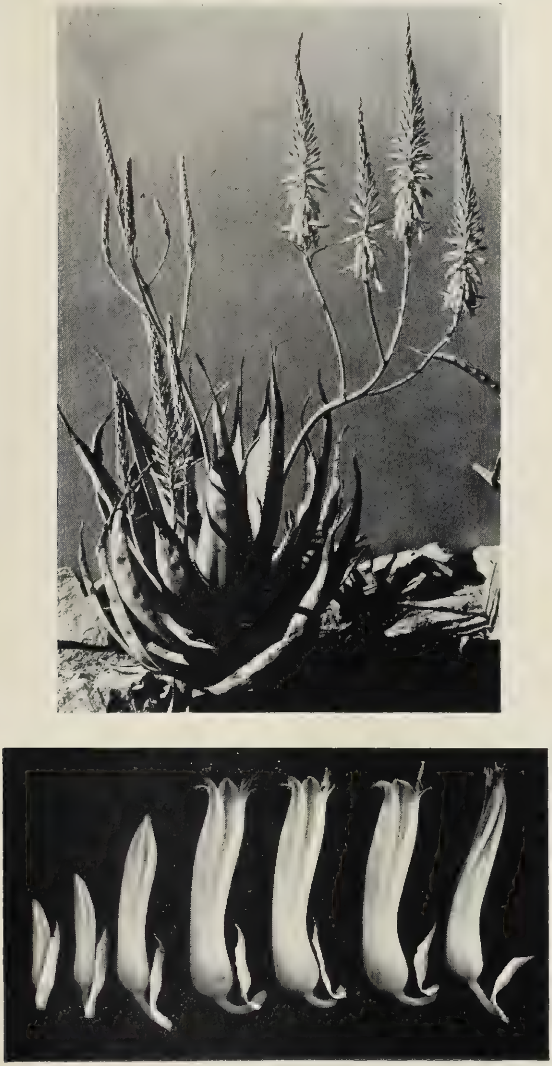


Plate X

Aloe dhalensis Lavranos.

Plant from Dhala on the Amiri highlands flowering in Johannesburg. Height 80 cm. Flowers 1/1, from bud to post-pollination stage. *Photos: Dr. G. W. Reynolds.*

described from the N.W. provinces of India and has been reduced into synonymy under *A. barbadensis* Mill.

The south-eastern corner of Arabia, wherein the Jebel Akhdhar lies, receives its rainfall in winter. Its vegetation, on the whole appears to be more closely related to that of Beluchistan, Iran and the Mediterranean regions of North Africa and Arabia, than to that of the western portion of Southern Arabia. It also lies—in the wider sense—within that region of the world whence many of the medicinal and aromatic plants used by the ancients originated.

Such being the case, it is possible that the mountains of South East Arabia (and perhaps the neighbouring area of Iran), were the original home of *A. barbadensis* Mill. (= *A. vera* L.) and that this plant, valued for its medicinal properties, was spread, by human hand, along the incense and spice routes of the ancient world, to the east and to the west of its original habitat. It may, thus, have attained its present, almost cosmopolitan distribution. It is, perhaps, no mere coincidence that *A. barbadensis* thrives mostly in warm temperate regions with a winter rainfall and, generally, a climate reminiscent to that prevailing in the mountains of Oman.

Six new species can now be described. In doing this and in view of my long co-operation with Mr. D. S. Hardy of Pretoria in matters concerning the genus *Aloe*, I have joined this name to my own as co-author of one of the new species.

Aloe dhalensis Lavranos. Nova species affinis *A. vacillanti* Forsk., sed foliis minoribus, inflorescentia valde breviore, perianthio luteo differens.

Planta solitaria vel sobolifera, acaulis vel cauli valde brevi munita; *folia* ad 18, erecta vel adscendentia, apice acuta, ca. 40 cm. longa, basi 8 cm. lata 5—8 mm. crassa; *supra* glauca, non maculata leviter canaliculata; *subtus* convexa; foliorum margines dentibus brunneis pungentibus, deltoideis, 2—3 mm. longis, 5 mm. inter sese distantibus armati; *inflorescentia* simplex vel saepe 3-vel 4-ramosa, a 70 cm. alta, ramis adscendentibus; *pedunculus* basi plano-convexus, ca. 12 mm. latus, deinde teres; *racemi* anguste conico-cylindrici, 19 cm. longi, 7 cm. diam., subdensi; *bracteae* lanceolatae, acutae, 11 mm. longae, 5 mm. latae, albidae, valde scariosae, 7—9-nerviae; *pedicelli* citrei, 5 mm. longi; *perigonium* citreum, 30 mm. longum, sub-cylindricum, supra ovarium 6 mm. diam., segmentibus exterioribus per 10 mm. liberis, obscure trinerviis, apicibus sub-acutis, leviter recurvatis, segmentibus interioribus latioribus; *filamenta* albida, filiformia, complanata; *antherae* demum per 2—3 mm. exsertae; *stigma* demum 3 mm. exsertum; *ovarium* olivaceum, 6 mm. longum, $2\frac{1}{2}$ mm. diam. (Plate X.)

HABITAT: South-Western Arabia, Amiri Highlands near Dhala, alt. appr. 4,800 ft. (1,460 m.) lat. 13° 42′N., long. 44° 44′E., coll. Ken Guichard, 1949, fl. Johannesburg 26 April 1953, Reynolds 6227 holotype (PRE); foot of castle hill at Dhala, 4,950 ft., 24 August 1962, Lavranos 1885; on Jebel Jihaf, 6,500 ft. 25 August 1962, Lavranos 1884; near Dhala air-strip, 4,800 ft. 10 July 1964, J. H. Gross in Lavranos 3393.

DESCRIPTION

Plant solitary, or producing off-shoots, acaulous or with a short, usually erect stem.

Leaves about 18, erect to ascending-erect, densely rosulate, lanceolate, tapering to a rather acute apex, about 40 cm. long, 8 cm. broad at base, 5—8 mm. thick; *upper surface* glaucous-green, sometimes with light brown tinge, unicoloured, flat or slightly canaliculate; *lower surface* same in colour as the upper, convex; *margins* armed with brown, pungent, deltoid teeth 2—3 mm. long, 5 mm. distant but more so towards the apex; *leaf-sap* drys dark purple.

Inflorescence simple or, more often, up to 4-branched, up to 70 cm. high.

Peduncle plano-convex and appr. 12 mm. broad at base, thereafter terete; sterile bracts white, lanceolate-deltoid, very scarious, many-nerved.

Racemes narrowly conico-cylindric, 20 cm. long, 7 cm. diam., subdensely flowered, terminated in a tuft of wilted bracts, youngest buds sub-erect, older buds spreading, open flowers pendulous.

Bracts lanceolate, acute, 12 mm. long, 5 mm. broad, papery, white, 7—9-nerved.

Pedicels lemon, 5 mm. long.

Perianth lemon-yellow, smooth, 30 mm. long, sub-cylindric, obtusely tapering into the pedicel at base, 6 mm. diam. over the ovary, then constricted on underside to 5 mm. diam., thereafter laterally compressed and enlarged towards the throat, the mouth wide open; *outer segments* free for 10 mm., obscurely 3-nerved, the nerves greenish near apex, the apices sub-acute, slightly spreading, *inner segments* free but dorsally adnate to the outer to beyond the middle, broader than the outer, with 3 congested, greenish nerves forming a keel throughout their length, and with broader, more obtuse, more spreading apices.

Filaments almost white, filiform flattened, the 3 inner narrower and lengthening before the 3 outer, the *anthers* in turn exserted by 2—3 mm.

Style lemon, the stigma at length exserted by 3 mm.

Ovary pale olive-green, 6 mm. long, $2\frac{1}{2}$ mm. diam.

This species was first collected in 1949 by Mr. Ken Guichard near Dhala which lies some 90 miles North of Aden, in the Amiri highlands. A plant was sent to Mr. P. R. O. Bally at Nairobi and then forwarded to Dr. G. W. Reynolds, in whose care it first flowered on the 26 April 1953. Dr. Reynolds drew up a full description of this young plant and I have taken over much of this in

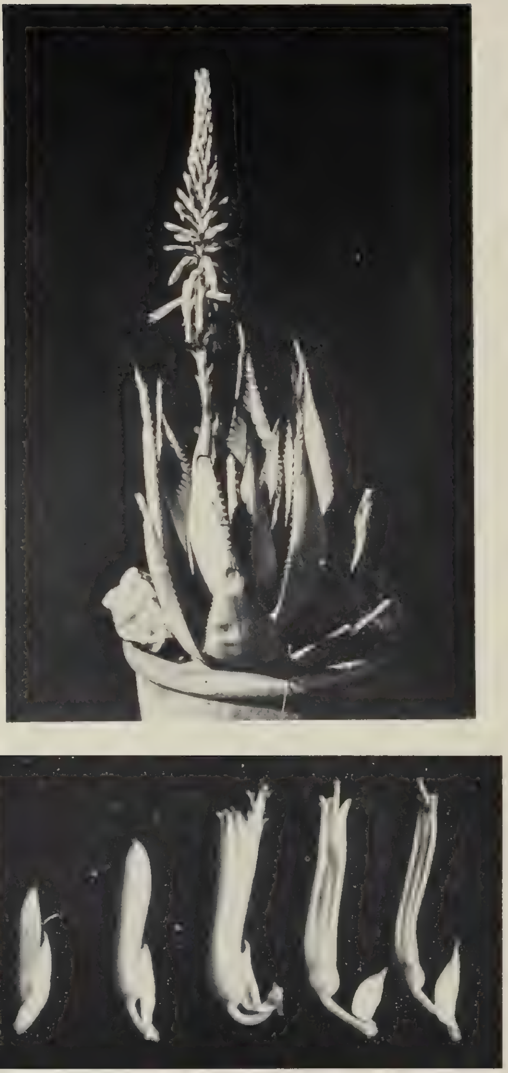


PLATE XI

Aloe audhalica Lavranos et Hardy.

A young plant from Wadi Salul, Audhali Plateau, flowering at Bryanston, Johannesburg. Height 50 cm. Flowers 1/1, from bud to post-pollination stage.

compiling the present paper, particularly so as I did not find the species in flower.

When I visited Dhala in August 1962, the plants were not flowering. It appears that in their natural habitat they do so in October or November. *A. dhalensis* seems to be widespread on the Amiri highlands where it occurs in scattered colonies between approx. 4,000 feet at the top of the Khureiba Pass, East of Dhala, to 6,500 feet on the slopes of Jebel Jihaf. The area of its distribution probably extends in the direction of Ta'izz.

These high plateaux enjoy a mild climate and an annual rainfall averaging some 350 mm., which falls mainly between April and September. The vegetation consists mainly of thorn scrub in which *Acacia tortilis* (Forsk.) Hayne, and a *Euphorbia* of sect. *diacanthium* predominate.

It may be noted here that von Wissmann's collections listed by O. Schwartz (*Fl. Trop. Arab.*, 350 (1939) under numbers W827 and W2397 as belonging to *A. officinalis* Forsk. no doubt represent *A. dhalensis.*

A. dhalensis appears to be more closely allied to *A. vacillans* Forsk., than to any other of the species hitherto described. It is however, a much smaller plant with inflorescences reaching 70 cm. in height as compared with those of *A. vacillans* which are stated to be up to 2 m. tall; moreover, in the new species the inflorescence is, more often than not, 3-branched. It may finally be noted that *A. dhalensis* is usually stemless or has a very short, erect stem while its ally often has a decumbent stem.

Aloe audhalica Lavranos et Hardy. Nova species, affinis *A. vacillanti* Forsk., sed foliis brevioribus latioribusque, inforescentia valde breviore, recemis brevioribus densioribusque, pedicellis a 10 mm. longis differt.

Planta fere solitaria; folia tenus 30, deltoidea, acuta, a 45 cm. longa basi 15 cm. lata, *supra* plana, apicem versus leviter canaliculata, unicoloria, glauco-viridia vel roseobrunnea, asperiuscula; *subtus* convexa, marginibus roseis, cartiligineis, dentibus fusco-brunneis, pungentibus, strictis, tenus 4 mm. longis, 4—6 mm. distantibus armata; *inflorescentiae* 80—100 cm. altae, fere 3—4-ramosae; *pedunculi* basi plano-convexi, deinde teretes; *racemi* late conici. 18—22 cm. longi, 5 cm. diam., mediocriter densiflori; *bracteae* ovatae-deltoideae, acutae, 16 cm. longae, basi 5 mm. latae, albidae, nervis 7, rubris ornatae; *pedicelli* rubri, teretes, 10 mm. longi; *perigonia* coccinea, stricta, cylindrico-triquetra, 30 mm. longa, supra ovarium 6 mm. diam., deinde vix constricta, segmentibus exterioribus per 8 mm. liberis, 3-nerviis, interioribus latioribus; *filamenta* flavida, *antherae* deinceps per 3—4 mm. exsertae, *stigma* demum per 4 mm. exsertum; *ovarium*, luteo-virens, 6 mm. longum, 3 mm. diam. (Plate XI.)

Habitat: South-Western Arabia, Audhali Plateau; near Mukeiras, 6,900 ft. (2,100 m.) lat. 45° 41′N., long. 13° 56′E., coll. 25 Dec. 1961, fl. Johannesburg, April 1964, Meintjes in Lavranos 1652, (PRE) holotype; Mukeiras, 16 Aug. 1962, Lavranos 1817; Karish, 7,100 ft. (2,160 m.) 18 Aug. 1962, Lavranos 1896; Wadi Idhi, 6,800 ft. (2,070 m.) 4 March 1964, Rauh et Lavranos 2789; Wadi Salul, 6,800 ft. (2,070 m.) 5 March 1964, Rauh et Lavranos 2800.

Description

Plant usually solitary, occasionally forming groups of several rosettes.

Leaves up to 30, deltoid-acute, densely rosulate, ascending-erect, to 45 cm. long, 15 cm. broad at base; *upper surface* flat but somewhat canaliculate towards, the apex, somewhat rough, uniformly glaucous-green when in complete shade, otherwise pinkish-brown; *lower surface* convex, same in colour as the upper surface; *margins* with a continuous, pink cartilaginous border armed with pungent, straight, dark brown teeth, up to 4 mm. long, 4—6 mm. distant.

Inflorescence 80—100 cm. high, up to 4-branched from about the middle.

Peduncle at base plano-convex, terete upwards, grey-brown with a bloom, sterile bracts deltoid, acute, to 15 mm. long, 5 mm. broad at base, 7-nerved, white, scarious.

Racemes 18—22 cm. long, about 5 cm. diameter, cylindric-acuminate, rather densely flowered.

Bracts ovate-deltoid, acute, 15 mm. long, 5 mm. broad at base, pinkish-white, 7-nerved, the nerves red.

Pedicels red, terete, 10 mm. long.

Perianth glabrous, straight, cylindric-trigonous very slightly constricted above the ovary, scarlet, 30 mm. long, 6 mm. diameter over the ovary; *outer segments* free for 8 mm., 3-nerved with creamish margins, *inner segments* broader than the outer, cream with 3 contiguous nerves which become confluent and brown at the segment-apices.

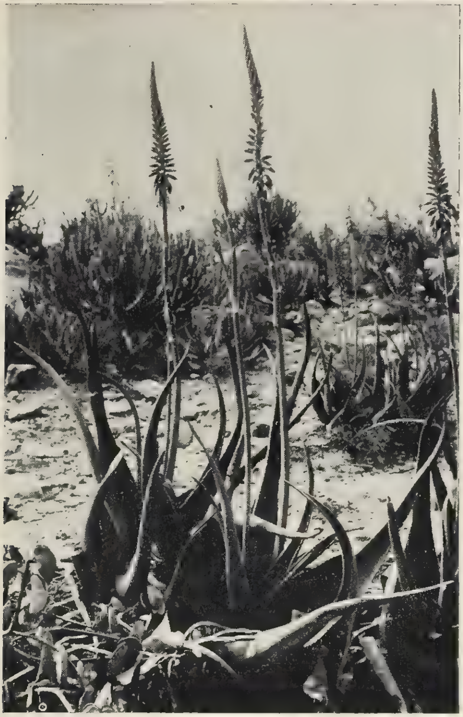
*Filament*s cream, the 3 inner narrower and lengthening before the 3 outer the *anthers* in turn exserted by 3—4 mm.

Style cream, the *stigma* at length exserted by 4 mm.

Ovary truncate, yellowish-green, 6 mm. long, 3 mm. broad at base.

Sap clear, drying reddish-brown.

A. audhalica is widespread in rocky, sunny places throughout the Audhali plateau at altitudes exceeding 6,650 ft. (2,000 m.) Its distribution probably extends into the adjacent district of Beidha. It is a circumstance worthy of note that this species, while widely distributed on the plateau itself was nowhere found within less than half a mile from the edge of the escarpment which, in turn, is the habitat of another species as yet unidentified. In its habitat which enjoys an average annual rainfall of some 12 inches and is subject to occasional



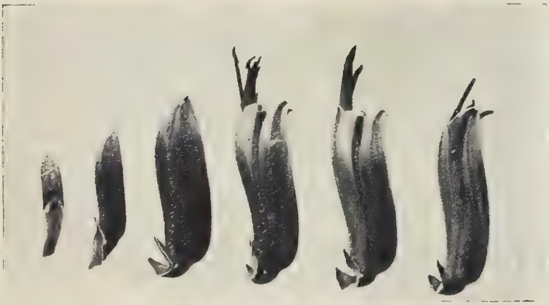


PLATE XII

Aloe niebuhriana Lavranos.

Plants in large numbers on rocky hill, south of Tor al Baha. Subaihi country. Height 1·20 m. *Photo: Lavranos*

Flowers red, 1/1, from bud to post-pollination stage *Photo: Dr. G. W. Reynolds* frosts during the winter months, *A. audhalica* grows in exposed positions in association with various low Acanthaceae and Labiatae, *Dracaena serrulata* Bak., *Euphorbia balsamifera* Ait., *Caralluma quadrangula* (Forsk.,) N.E.Br., *C. plicatiloba* Lavranos, etc., It is nowhere common but is found in isolated individuals or small groups.

A. audhalica seems to be rather closely allied to *A. vacillans* Forsk., which was collected at various places in the central region of the Western Yemeni escarpment. *A. vacillans* however, differs in the shape of its leaves, which are longer and narrower, in having inflorescences 1·5—2 m. tall, while its racemes are said to be 35—40 cm. long and more laxly flowered and finally by the fact that its flowers are described by Forskal as subsessile, while Berger attributes to the pedicels a length of 5—7 mm.

Of all the Aloes which I collected in Southern Arabia the one here described has been the most difficult to identify. While our knowledge of *A. vacillans* Forsk. remains incomplete, I consider it advisable to assign specific rank to this form from the Audhali Plateau.

Aloe niebuhriana Lavranos. Nova species, affinis *A. trichosanthae* Berger, sed foliis plus numerosis, maculatis, inflorescentia breviore, plerumque simplici, racemis brevioribus, segmentis exterioribus perianthii per 19—21 mm. liberis differt.

Planta succulenta, fere sobolifera, acualis vel caule brevi, procumbente; *folia* 15—25, rosulata, erecto-patula, lanceolata-attenuata, a 45 cm. longa, basi 10 cm. lata, 5—8 mm. crassa, *supra* glauco-viridia, brunneo-tincta, late canaliculata, *subtus* convexa; *margines* foliorum dentibus fusco-brunneis saepe acutis, 1·5—2 mm. longis, 12—15 mm. distantibus armati; *inflorescentiae* 50—100 cm. altae, simplices vel rarius 1-vel 2-ramosae, ramis brevibus, arcautis-adscendentibus; *pedunculi* basi plano-convexi 15 mm. lati, deinde teretes; *racemi* densiflori late conici, 12—30 cm. longi, 5—6 cm. diam.; *bracteae* anguste deltoideae, acutae, 8 mm. longae, basi 3—4 mm. latae, albidae, scariosae, 5—7-nerviae; *pedicelli* rubri vel flavovirides, teretes, fere minute pubescentes, rarius glabri, 4—6 mm. longi; *perigonia* rubra (vel interdum flava) plerumque pubescentia, rarius omnino glabra vel apicibus segmentum papilloso-tomentosis, cylindrico-campanulata, 28—31 mm. longa, 6—7 mm. diam., ad orem parum constricta, segmentibus exterioribus per 19—21 mm. liberis, trinerviis, apice recurvatis, interioribus latioribus; *filamenta* flava filiformia, complanata; *antherae*, demum per 3—4 mm. exsertae; *stigma* aetatae exsertum per 4 mm; *ovarium* 6 mm. longum, 2·5 mm. diam. (Plates XII and XIII.)

HABITAT: South Western Arabia; Am Rija (Da'ar al Kudeimi) in the Subaihi country, 1952, Gilliland in Reynolds 6362, fl. Johannesburg January 1960; Haushabi country, 5 miles south of al Milah, 1,200 ft. (350 m.), 13° 45′N., 44° 50′E., 24 Aug. 1962, Lavranos 1863; Subaihi country, on rocky slope near

Tor al Baha, alt. appr. 1,200 ft. (350 m.), lat. 13° 10′N., long. 44° 19′E., 31 March 1964, Rauh et Lavranos 3159, holotype (PRE), isotype (K); Da'ar al Kudeimi, 800 ft. (250 m.), 31 March 1964, Rauh et Lavranos 3156, perianths scarlet, glabrous; 3 miles south of Tor al Baha, 31 March 1964, Rauh et Lavranos 3168, perianths yellow, glabrous, (PRE, K) and Rauh et Lavranos 3169, perianths scarlet, pubescent; 4 miles south of Tor al Baha, 31 March 1964, Rauh et Lavranos 3170, perianths papillose tomentose.

DESCRIPTION

Plant usually, when growing in soft, sandy soil, suckering freely and forming dense groups but when growing on rocky ground, usually solitary, acaulous or with a short procumbent stem.

Leaves 15—25 rosulate, spreading or ascending-spreading, lanceolate-attenuate, tapering to an acute, dentate apex, up to 45 cm. long, 10 cm. broad at base, 5—8 cm. thick; *upper surface* uniformly grey-green with a purplish tinge, broadly canaliculate throughout; *lower surface* same in colour as the upper, convex; *margins* armed with dark brown, blunt or acute teeth, 1·5—2 mm. long, 12—15 mm. distant.

Inflorescence 50—100 cm. high, usually simple, sometimes 1- or 2-branched from its upper third, the branches short, arcuate-ascending.

Peduncle flattened and about 15 mm. broad at base, terete upward, purplish-green with a bloom, minutely pubescent in its terminal portion, less often glabrous throughout; sterile bracts below the racemes whitish, many nerved, deltoid, 8 mm. long, 6 mm. broad at base.

Racemes rather broadly conical, 12—30 cm. long, 5—6 cm. diameter, densely flowered, youngest buds suberect, older buds horizontally spreading, open flowers nutant.

Bracts narrowly deltoid, acute, 8 mm. long, 3—4 mm. broad at base, whitish scarious, 5—7-nerved.

Pedicels red or greenish-yellow, terete, usually minutely pubescent, less often glabrous, 4—6 mm. long.

Perianth scarlet (or rarely greenish yellow), with greenish yellow segment apices, usually shortly pubescent throughout, less frequently glabrous or papillose-tomentose on the free part of the outer perianth-segments, cylindric-campanulate, shortly stipitate, 28—31 mm. long, 6—7 mm. diameter throughout their entire length, the mouth slightly constricted; *outer segments* free for 19—21 mm. with 3 nerves which are red, (or rarely yellow) low down, becoming bright green and confluent towards the recurved segment-apices; *inner segments* broader and more recurved than the outer, free but dorsally adnate to the outer, yellow with 3 nerves which are red (or rarely yellow) low down becoming bright green upward.

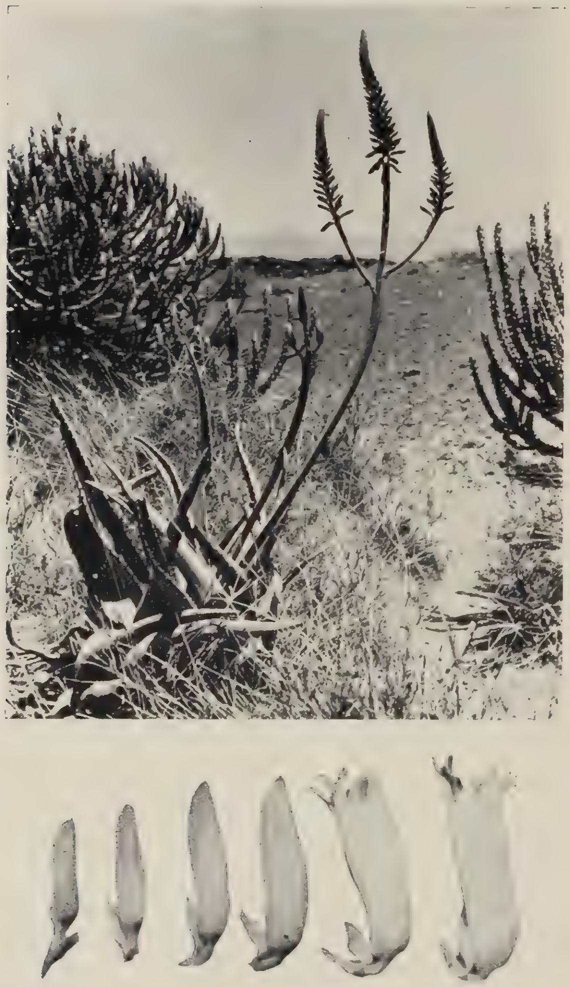


Plate XIII

Aloe niebuhriana Lavranos.

Photograph of plant near Da'ar al Kudeimi, Subaihi country, showing the characteristic branching of the inflorescence. Height 90 cm. *Photo: Prof. W. Rauh*

Flowers 1/1, of the yellow-flowering form, from bud to post-pollination stage.

Filaments yellow, filiform-flattened, the three inner narrower and lengthening before the outer, the *anthers* in turn exserted by 3—4 mm.

Style yellow, the *stigma* at length exserted by 4 mm.

Ovary 6 mm. long, 2·5 mm. diameter.

A. niebuhriana grows in the hot, arid foothills which lie between the mountain ranges of the interior and the wide coastal plain in the Western part of the Aden hinterland. It also occurs in the low-lying valleys which dissect the seaward ranges of the mountains. It is a dominant component of a semi-desert vegetation in which its chief associates are *Salvadora* cf. *persica* Garcin, *Euphorbia qarad* Defl. *Tamarix articulata* Vahl, *Zizyphus spina-christi.* (L) Willd., various species of *Commiphora* etc. It was not observed above 1,500 ft. (500 m.). In contrast to all other species of Aloe native to the Southern fringe of Arabia (with the possible exception of *A. inermis* Forsk.) *A. niebuhriana* is most prolific in its natural habitat, forming large and dense colonies.

The closest ally of this species appears to be *A. trichosantha* Berger, from Eritrea and Ethiopia which, however, differs in having less numerous, usually spotted, leaves with much larger marginal teeth and much taller and usually 3-branched inflorescences. In the new species the racemes are usually broadly conical and average only 20 cm. long on average, while the young buds are not hidden by the bracts which are 8 mm. long. Finally the perianths in *A. niebuhriana* are more campanulate and less slender than in its ally, being rather constricted at the mouth; the outer segments are free for two-thirds of their length while in *A. trichosantha* their free portion represents less than one-half of their length.

While in *A. niebuhriana* the flowers open, as in most other species of Aloe, from the bottom upwards, there are usually a few isolated buds at the very base of the raceme which open long after the lower portion of the raceme has finished flowering. The inflorescences are usually simple but, when they branch, they do so from their upper third only, in a fashion which may be described as dichotomous; this is clearly shown in Plate XIII.

While many plants have been named after Peter Forskal the botanist of the expedition sent to Arabia by King Frederick V of Denmark in 1762, none, it appears, were dedicated to the memory of the intrepid Carsten Niebuhr, the only member of this expedition to return to Europe. Apart from his invaluable contribution to Europe's knowledge of Arabia, Niebuhr saved for posterity a considerable part of Forskal's collections and papers and published, at his own expense, Forskal's *Flora Aegyptiaco-Arabica.* This species is named after Carsten Niebuhr as a very small tribute to his memory.

A. eremophila Lavranos. Nova species affinis *A. rigenti* Reynolds et Bally var. *glabrescenti* Reynolds et Bally, sed foliis brevioribus, adscendentibus, rigidissimis, inflorescentia breviore 4—5-ramosa, racemis cylindratis, comosis, pedicellis longioribus, perianthiis glabris, prope strictis, segmentibus exterioribus perianthii per 14 mm. liberis differens.

Planta plerumque solitaria acaulescens vel caule brevi, procumbente; *folia* 10—22 arcauto-adscendentia, deltoidea, acuta, rigidissima, 35 cm. longa, basi 10 cm. lata, 15—25 cm. crassa, supra glauco-viridia, brunneotincta, immaculata, basi plana, deinde late canaliculata, subtus convexa; margines foliorum dentibus fuscobrunneis, pungentibus, tenus 4 mm. longis, 10—15 mm. distantibus armati; *inflorescentiae* 40—75 cm. altae, 3—5-ramosae; *penduncuIi* basi bisconvexi, 15 mm. lati, deinde teretes, striati; *racemi* conico-cylindrici, a 22 cm. longi, 5 cm. diam., fere densiflori, laterales medio interdum breviores; *bractae* anguste deltoideae, 8—12-nerviae, 12 mm. longae, 5 mm. latae, albescentes; *pedicelli* teretes 7—8 mm. longi; *perigonia* coccinea, glabra, cylindrico-trigona, prope stricta, brevissime stipitata, 30 mm. longa, segmentibus exterioribus per 14 mm. liberis, apicibus leviter recurvatis, interioribus latioribus; *filamenta* flava, basi paulum complanata *anthreae* deinceps per 4 mm. exsertae; *stigma* demum per 5 mm. exsertum; *ovarium* flavo-virescens, 5 mm. longum, 2 mm. diam., apice trancatum. (Plate XIV.)

HABITAT: Southern Arabia, Hadhramaut, on limestone Plateau (Jol); 8 miles north of Mola Matr (which is 54 miles N.W. of the port of Mukalla) 6,400 ft. (1,900 m.) 20 March 1964, Rauh et Lavranos 3,100; near village of Fardha, approx. 20 miles N.W. of Mola Matr. 5,500 ft. (1,674 m.) 20 March 1964, Rauh et Lavranos 3103 both collected on 20 March 1964; East of Khureiba (Wadi Duan) approx. 4,500 ft. (1,375 m.) lat. 15° 02′N., long. 48° 28′E., 20 March 1964, Rauh et Lavranos 13348 (HEID) holotype, (K, PRE) isotype.

DESCRIPTION

Plant usually solitary, sometimes forming groups of 2—6 rosettes, acaulous or with a short, procumbent stem.

Leaves 10—22 arcuate-ascending to ascending erect, deltoid, acute, very rigid, 35 cm. long, 10 cm. broad at base, 15—25 mm. thick; *upper surface* uniformly grey-green with a brownish tinge, flat low down, broadly canaliculate upward; *lower surface* convex, same in colour as the upper surface; *margins* armed with dark brown, pungent, deltoid teeth up to 4 mm. long, 10—15 mm. distant but more crowded and smaller near base.

Inflorescence 40—75 cm. high, 3- to 5-branched from about the middle.

Peduncle biconvex and 15 mm. broad at base, terete upward, striated, the branches terete, subtended by ovate-deltoid, many-nerved bracts 14 mm. long, 18 mm. broad; sterile bracts below the racemes narrowly deltoid-acute, 8—12 nerved, 12 mm. long, 5 mm. broad.

Racemes conico-cylindric up to 22 cm. long. 5 cm. diameter, rather densely flowered, terminating in a dense tuft or spike of wilted scarious bracts, the

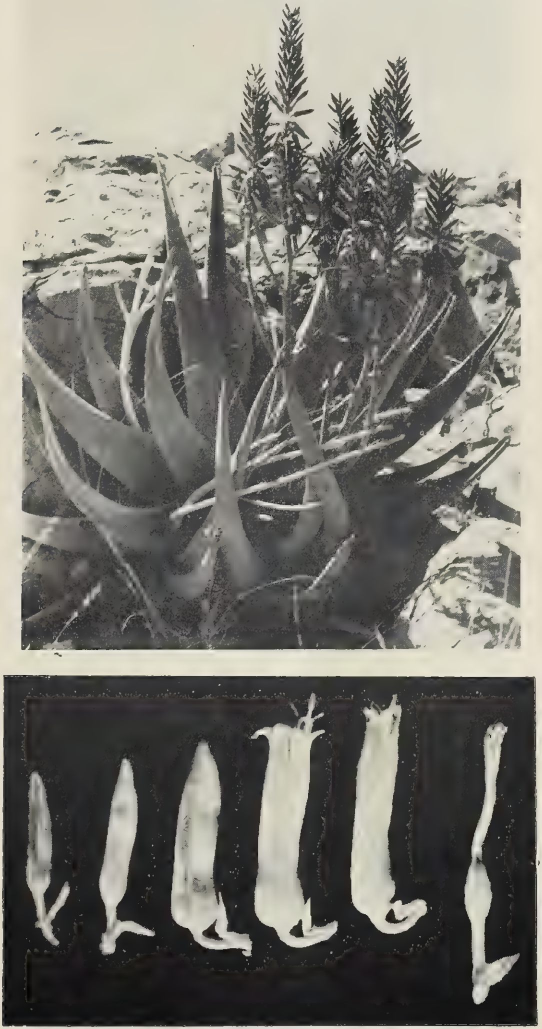


PLATE XIV

Aloe eremophila Lavranos.

Plant on the Hadhrami Jol, east of Khureiba. Height 60 cm.
Flowers 1/1, from bud to post-pollination stage.

lateral racemes often shorter, young buds sub-erect, old buds spreading, open flowers pendulous.

Bracts narrowly deltoid, 8—12 nerved, 12 mm. long, 5 mm. broad, white.

Pedicels red, terete, 7—8 mm. long.

Perianth rich scarlet, glabrous, cylindric-trigonous, almost straight, very shortly stipitate, 30 cm. long. 8 mm. diameter across the ovary, slightly constricted above, somewhat compressed laterally, the mouth wide open; *outer segments* free for 14 mm. with three prominent red nerves throughout their entire length, the nerves becoming confluent and brownish towards the yellowish and slightly recurved apices of the segments; *inner segments* free but dorsally adnate to and broader than the outer, creamy-yellow with 3 red nerves which become confluent and brownish toward the segment-apices.

Filaments yellow, somewhat flattended in their lower part, the 3 inner narrower and lengthening before the 3 outer, the anthers in turn exserted by 4 mm.

Style pale yellow, the *stigma* at length exserted by 5 mm.

Ovary yellowish-green, 5 mm. long, 2 mm. diameter, the apex truncate.

A. eremophila was first collected on 20 March 1964 on the Hadhrami Jol during a botanical journey from Mukalla on the coast of the Arabian Sea to the Wadi Hadhramaut. It is a plateau species and occurs in isolated individuals or small colonies at intervals of many miles, from just north of the seaward escarpment at 6,500—7,000 ft. for 100 miles to the cliffs overlooking the Great Wadi, at 3,500 feet.

In the high, southern part of its habitat it is associated chiefly with *Aloe inermis* Forsk., *Euphorbia balsamifera* Ait., *Kalanchoe teretifolia* Defl. with scrub-forest remnants consisting chiefly of *Dodonaea viscosa* L. and *Acacia tortilis* (Forsk.) Hayne. Further north, at lower altitudes, its chief associates are—besides *A. tortilis*—*Sarcostemma* cf. *stipitaceum* Forsk. and *Anisotes trisulcus* (Forsk.) Nees. Hot in summer, very cold in winter, this windswept plateau is now, for by far its greater part, a complete desert although there is much evidence that this has not always been so and that the present lack of vegetation is due to the destructive influences of man and goat.

A. eremophila is a close ally of the Somali species *A. rigens* Reynolds et Bally, from the typical form of which it differs by being a smaller plant with fewer, broader, shorter, deltoid leaves, shorter inflorescences, shorter more cylindric racemes, longer pedicels and totally glabrous, almost straight perianths. It differs from the variety *glabrescens* Reynolds et Bally by its shorter, less numerous, much more rigid and thick leaves, its shorter, usually 4—5-branched inflorescences, its more cylindric racemes which are invariably terminated by a tuft of white sterile bracts, its longer pedicels and bracts and its glabrous almost straight perianths the outer segments of which are free for 14 mm.

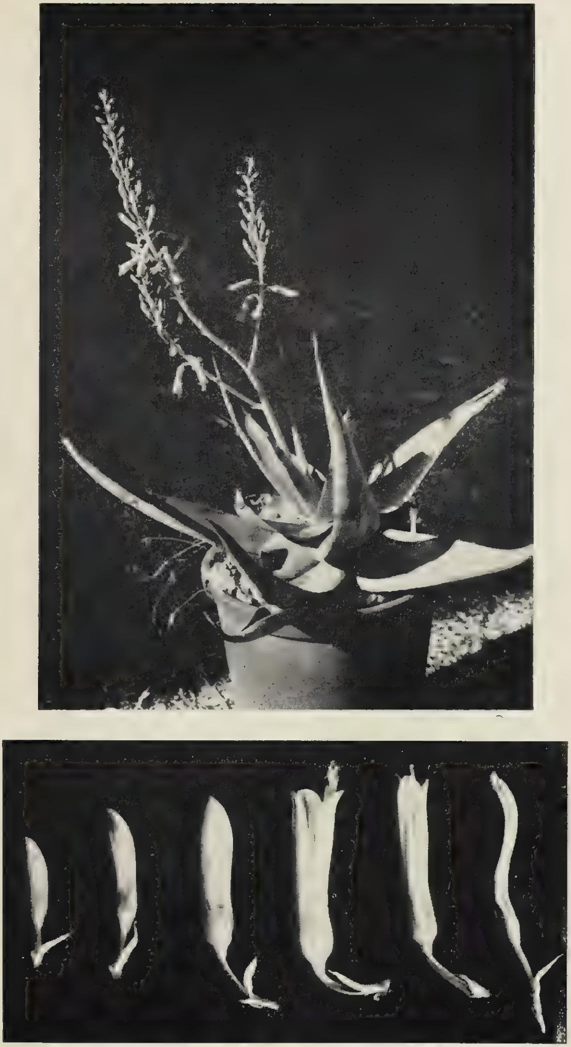


Plate XV

Aloe serriyensis Lavranos.

A plant from the Jebel Arays, flowering at Bryanston, Johannesburg. Height 50 cm. Flowers 1/1, from bud to post-pollination stage.

A. serriyensis Lavranos. Nova species, affinis *A. eremophilae* Lavranos sed foliis angustioribus, minus dentatis, lineatis-striatis, racemis laxioribus, perigoniis cylindrico-campanulatis, brevioribus, prominente stipitatis, segmentis perigonium solum per 8 mm. liberis differt.

Planta fere solitaria, acaulis vel caule breve, decumbente; *Folia* 30—35 cm. longa, basi 6—7 cm. lata, sensim attenuata, apice acuta, 5—8 mm. crassa, obscure lineata-striata, aliquantum molla; *supra* viridia, plana vel late canaliculata; *subtus* leviter convexa; *margines* dentibus obtusiusculis, brevibus, cartilagineis, fusco-brunneis, 20—40 mm. inter sese distantibus armati; *Inflorescentiae* 40 cm. altae, 2—3-ramosae; *Pedunculus* basi plano-convexus, ca. 10 mm. latus, deinde teres; *Racemi* conici, 20—25 cm. longi, 5 cm. diam., laxiusculi; Bracteae anguste deltoideae, 8—10 mm. longae, basi 3 mm. latae, albidae, scariosae, 5-nerviae; *Pedicelli* teretes, 10 mm. longi; *Perigonia* leviter infundibuliformia, cylindirco-campanulata, prominente stipitata, roseo-coccinea, 27 mm. longa, supra ovarium 6 mm. diam., deinde vix constricta, ad orem latiora, segmentibus exterioribus per 7—9 mm. liberis, tri-nerviis, interioribus latioribus, valde recurvatis; *Filamenta* basi albida et complanata, supra flava et filiformia; *antherae* deinceps per 2 mm. exsertae; *Stigma* aetatae per 3 mm. exsertum; *Ovarium* clare viride, 4 mm. longum, 2 mm. diam. (Plate XV.)

HABITAT: Southern Arabia, Fadhli country, in wooded valleys on the southern slopes of Jebel Arays around the derelict village of Serriya, alt. 1,000 ft. (300 m.) lat. 13° 29′N., long. 45° 58′E., 19 Aug. 1962, fl. Johannesburg 20 July 1964, Lavranos 2101 (PRE) holotype.

DESCRIPTION

Plants usually forming small groups.

Leaves 30—35 cm. long, 6—7 cm. broad at base, gradually tapering to an acute apex, 5—8 mm. thick, rather soft; *upper surface* green, sometimes with a brownish tinge, obscurely lineate-striate, flat or broadly canaliculate; *lower surface* flat to slightly convex, same in colour and texture as the outer surface, *margins* armed with short, rather blunt, horny, dark brown teeth, 20—40 mm. distant.

Inflorescence 40 cm. high, 2—3-branched.

Peduncle rather brittle, biconvex and 10 mm. broad at base, terete upwards, brown with a bloom; sterile bracts deltoid, acute, 10 mm. long, 6 mm. broad at base.

Racemes conical 20—25 cm. long, approx. 5 cm. diam., rather laxly flowered, usually with a long sterile, bracteate apex, young buds sub-erect, old buds spreading, open flowers pendulous.

Bracts narrowly deltoid, 8—10 mm. long, 3 mm. broad at base, 5-nerved, whitish, scarious.

Pedicels brownish, terete, 10 mm. long.

Perianth cylindric-campanulate, markedly stipitate and tapering into the pedicel, powdery scarlet-pink with a bloom, 27 mm. long, 6 mm. diameter over the ovary, thence scarcely constricted, the mouth wide open; *outer segments* free for 7—9 mm., with 3 red nerves which become brown and confluent towards the slightly recurved apices; *inner segments* broader than the outer, cream with strongly recurved apices.

Filaments whitish and much flattened at base, filiform and bright yellow in their upper portion, the *anthers* in turn exserted by 2 mm.

Style filiform, yellow, the *stigma* at length exserted by 3 mm.

Ovary bright green, 4 mm. long, 2 mm. diameter.

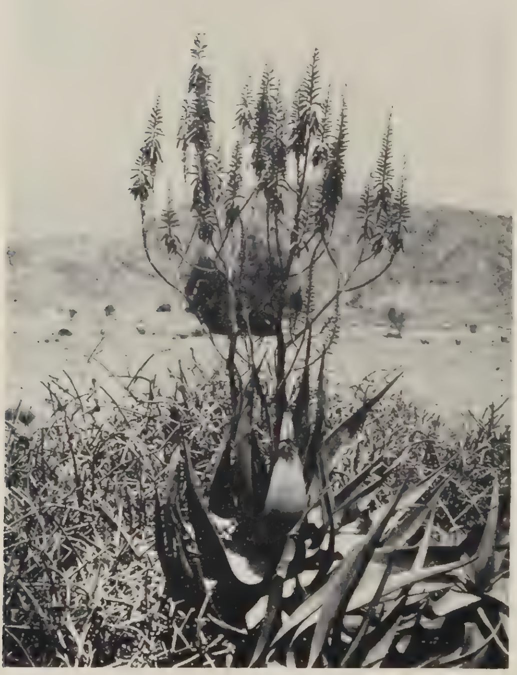
This species differs from *A. eremophila*, its closest ally, in being a much less robust plant. The leaves are narrower, softer, thinner and obscurely lineate-striate, while the marginal teeth are far less developed and more distant than in *A. eremophila*. The pedicels are longer and the perianths shorter, somewhat funnel-shaped and markedly stipitate while in its ally the stipus is almost absent. The outer perianth segments are free, on average, for 8 mm. (as against 14 mm. in *A. eremophila*).

The plant here described was collected at my request by an Arab from Shuqra when, in the company of Mr. C. Meintjes, I was passing through that village on the way to and from the Audhali country. Due to lack of time we were unable to collect in the Jebel Arays but, in March 1964, I visited this fascinating mountain country together with Professor Dr. W. Rauh.

The Jebel Arays rises steeply to some 4,500 ft. immediately behind the coast, some 75 miles east of Aden. Its slopes appear to catch the moisture-laden winds blowing off the Arabian Sea throughout the year and the valleys and ridges are covered with a luxuriant vegetation, quite unexpected along the arid coastline of S.W. Arabia. Near the ruined village of Serriya we saw several plants of Aloe which appeared to belong to the species here described.

Aloe splendens Lavranos. Nova species, paulum affinis *A. megalacanthae* Bak., sed caule absente vel brevi et procumbete, foliis latioribus, deltoideis apice nihil vel paulo decurvis, recemis longioribus, pedicellis brevioribus differt.

Planta saepe solitaria, acaulis vel caule prostato, tenus 40 cm. longo; *Folia* arcuata-adscendentia vel erecto-patula, late ensiformia, sensim attenuata, apice acuta, 60 cm. longa, basi 15 cm. lata, 10 mm. crassa, supra viridula, canaliculata, subtus plana vel late convexa, marginibus cartilagineis, fusco-brunneis, dentibus deltoideis, obtusiusculis, rigidis, 2 mm. longis, 15—30 cm. distantibus; *inflorescentiae* valde et repetite ramosae, 140 cm. altae; *peduncli* basi planoconvexi 30 mm. lati, deinde teretes; *recemi* usque a 15, conico-cylindrici, apice longo,



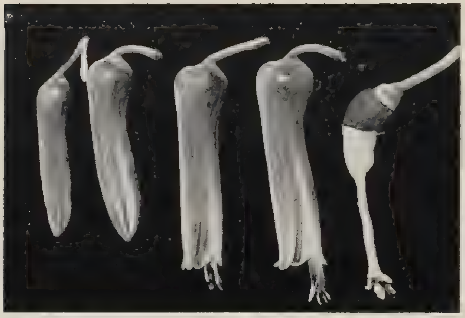


PLATE XVI

Aloe splendens Lavranos.

Plants on the sandy Dathina plain, east of Mudiya. Height 1·55 m. *Photo: Lavranos.*

Flowers 1/1, from bud to post-pollination stage. *Photo: Prof. W. Rauh.*

vacuo, bracteato, subdensi, 30—35 cm. longi, 6 cm. diam., laterales interdum paulo breviores; *bracteae* anguste deltoideae, 10 mm. longae, 6 mm. latae, scariosae, albidae, 7-nervatae, pedicelli rubro-brunnei, teretes, 8 mm. longi; *perigonia* rubra, 30—33 mm. longa, breviter stipitata, basi 8 mm. diam. deinde leviter constricta, cylindrico-trigona, segmentibus exterioribus per 13 mm. liberis, interioribus latioribus; *filamenta* basi albida, valde complanata, superne flava, filiformia; *antherae* deinceps per 3 mm. exsertae; *stylus* flavus; *stigma* tractu temporis per 4 mm. exsertum; *ovarium* viride, 7 mm. longum, apice truncatum (Plate XVI.)

HABITAT: South Western Arabia, Dathina plain, 6 miles East of Mudiya approx. 2,500 ft. (760 m.), lat. 13° 50′N., long. 46° 10′E., coll. 3 March 1964, Rauh et Lavranos 13008, (HEID) holotype, (K, PRE) isotype; 1 mile west of Mudiya, 3 March 1964, Rauh et Lavranos 2767; 2 miles east of Mudiya, 3 March 1964, Rauh et Lavranos 2768.

DESCRIPTION

Plant solitary or forming groups of up to 8 rosettes, usually acaulous but frequently with a prostrate stem up to 40 cm. long.

Leaves 20—24 ascending-spreading, deltoid-attenuate, acute, up to 60 cm. long, 15 cm. broad at base, 10 mm. thick; *upper surface* uniformly dull green, often with a purplish-brown tinge, flat, but canaliculate towards the apex; *lower surface* flat or broadly convex, same in colour as the upper surface; *margins* with dark brown cartilaginous border, armed with dark brown, hard, rather blunt, deltoid teeth, 2 mm. long, 15—30 mm. distant but more so towards the apex.

Inflorescence a much branched and rebranched panicle, 2—3 simultaneously, 140 cm. high, each with up to 15 racemes, making a total of over 40 racemes to a plant.

Peduncle plano-convex and 30 mm. broad at base, thereafter terete, somewhat elliptical in section, brown with a bloom, branched from below the middle, sterile bracts ovate-deltoid, 8—10 mm. long, scarious, white, 11-nerved.

Racemes conico-cylindric with a long sterile, bracteate apex, sub-densely flowered, 30—35 cm. long, 6 cm. diameter, the lateral racemes somewhat shorter, only the youngest buds sub-erect, all other buds spreading horizontally, open flowers nutant.

Bracts narrowly deltoid, 10 mm. long, 6 mm. broad at base, scarious, white, 7-nerved.

Pedicels red-brown, terete, 8 mm. long.

Perianth bright scarlet with a bloom, 30—33 mm. long, shortly stipitate, cylindric-trigonous, 8 mm. diameter over the ovary, thereafter constricted to 6 mm., widening to 7 mm. towards the laterally compressed mouth; *outer* *segments* free for 13 mm. with 3 dark, brownish nerves which become confluent towards the cream segment-apices; *inner segments* free, but dorsally adnate to the outer, broader but equal in length to the outer segments, with three rather congested, brown nerves throughout, broad cream margins and apices which are broader, more obtuse and more reflexed than in the outer segments.

Filaments much flattened and white at base, filiform and yellow thereafter, the 3 inner narrower and lengthening before the 3 outer, the *anthers* in turn exserted 3 mm.

Style yellow, the *stigma* at length exserted by 4 mm.

Ovary bright green, 7 mm. long, its apex truncate.

This magnificent species was first observed in flower by Mr. T. W. Hague, Agricultural Officer at Lodar in the Audhali Sultanate. When Professor Rauh and I visited this area and the adjacent Dathina country in March 1964, Mr. Hague directed us to the locality, some 6 miles east of the village of Mudiya where numerous plants were found growing in sparse scrub consisting mainly of 2 species of *Acacia* and one or two of *Commiphora*. Only one plant was found in full flower and it is from this that the type material was obtained.

Plants which may belong to this species were found a few miles further west near Lodar. Some very large plants which are conspicuous in the southern part of the Jahhayn flats at the edge of the desolate lava country of the Arqub, halfway between Lodar and the coastal village of Shuqra, may also belong here.

A. splendens is a beautiful plant, its beauty being in contrast with the austerity of its surroundings which is accentuated by the fact that the species seems to flower in March and early April, at the end of the long, dry season, when the country is covered in dust and the trees are devoid of foliage.

A. splendens does not seem to have close relatives, either in Arabia or in Africa. It appears to be rather distantly related to *A. megalacantha* Bak., which, however, has an erect stem 1—2 ft. high, narrower, strongly recurved leaves, considerably larger marginal teeth, shorter inflorescences, racemes and flowers and much longer pedicels.

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NOTES ON MESEMBRYANTHEMUM AND ALLIED GENERA

H. M. L. Bolus

Dorotheanthus martinii L. Bol. sp.nov.—Plantae ferae plures visae; folia saepius spathulata vel subspathulata vel fere linearia, obtusa vel rarius subacuta, rubra, 2·2—3 cm. longa, 3—7 mm. lata; flores maturi marcescentes tantum visi; pedunculi ad 1·7 cm. longi; receptaculum semiglobosum, 4 mm. longum, ad 5 mm. diam. vel 3 mm. longum, 6 mm. diam. vel in floribus senectis ad 7 mm., in fructu immaturo ad 1·2 cm., diam.; sepala 5, oblonga vel sublinearia, obtusa vel in flore senecto extima 2 basim versus latiora, 6—8 mm., vel 7—9 mm., vel 7—10 mm., vel 7—11 mm., longa, basi 2 mm., 3—4 mm., et 3—5 mm. lata, accrescentia, in fructu immaturo ad 1·3—1·7 cm. longa, basi 5—9 mm. lata, accrescentia, exterius unicum parum supra basim latam angustatum, prope apicem rotundum in latum crescens; petala 2-seriata, ex infra medium inferne, e supra medium superne, angustata, laete lutea, cum aetate pallida, ad 2·4 cm. longa, medio (in alabastro in aqua aperto) ad 2·5 mm. lato; filamenta ca. 5-seriata, saturate aurantiaca vel fere rubra, ad 3 mm. longa, antheris pollineque saturate aureis; discus inconspicuus; ovarium supra profunde concavum, lobis inconspicuis; stigmata 5, inferne leviter incrassata, superne attenuata, papillata, cum cauda breve ad 4·5 mm., vel in fructu immaturo ad 10 mm., longa accrescentia.

Cape Province: in dit. Robertson; "on the farm 'Eilandia', about 10 miles W. of Robertson, on a sandy slope facing north and only one small colony seen," Sept. 1964, *Martin C. Littlewood.* Karoo Garden 215/64.

Drosanthemum barwickii L. Bol. sp. nov. (*Aspericaulia-Carinata*).—Rami 3 visi, lignosi politi atrati, basi 3—4 mm. diam.; rami secondarii ascendentes, internodiis saepius 1—2·5 cm. longis; ramuli ultimi floriferi graciles, cum floribus 3—6 cm. longi; partes herbaceae glauce virides, papillis saepissime rotundis; folia erecta interdumque subfalcata, vel ascendentia, compressa carinataque, supra visa lanceolate linearia, e basi superne angustata, obtusa, lat. visa oblique rotunda vel subacuta, 7—11 mm. longa cum vagina ca. ad 1 mm. longa, 1·5—2 mm. lata, medio 2—3 mm. diam., basim versus conspicuiore papillosa, basi vaginae dense longeque papillosa; flores 2—2·5 cm. diam., diurni; pedunculi conspicue papillosi, ad 8 mm. longi; receptaculum obconicum, conspicue papillosum, 3 mm. longum, 4—5 mm. diam.; sepala 6, extima 2 inferne plana, superne compressa, prope medium 1·5—2 mm. diam., cetera oblonga vel linearia, apice acute breviterque subulato, omnia ± marginata, 4—6 mm. longa, basi 1·5—2 mm. lata; petala purpureo rosea, exteriora 2-seriata subspathulata, saepius 2-dentata, ad 9—10 mm. longa, fere ad 2 mm. lata, interiora perpauca, in staminodia transeuntia; staminodia mox recurva, rosea, stamina longissima aequantia; filamenta 3—4-seriata, primum fere erecta, mox subdiffusa, inferne alba, superne pallide rosea, ad 5 mm. longa, exteriora inferne ciliate papillata, interiora parum infra medium papillata, antheris pollineque primum pallide stramineis, deinde albis; glandulae approximatae vel fere coalitae, profunde divisae; ovarium circa marginem planum, deinde lobis erectis distantibus compressis, per 1 mm. elevatis; stigmata 6, inferne anguste subulata, longe attenuata, ad 3 mm. longa, cauda brevissima.

Cape Province; in dit. Swellendam; "3 miles from Bonnievale on the road to Goudmyn", Sept. 1964, *A. F. Barwick* 3720.

Drosanthemum tuberculiferum L. Bol. sp. nov. (*Aspericaulia-Semiteretia*).—Plantae 2 visae, ferae, sat graciles, caule ad 5 mm. diam.; rami primarii decumbentes, ad 12 cm. longi, internodiis 5—20 mm. longis, ad 2 mm. diam., apicem versus cum ramis secundariis papillis integris, subconicis vel ovalibus onusti; ramuli ultimi floriferi saepius 2-foliati, 1·5—2·5 cm. longi, axillo altero interdum gemmifero itaque ramulus floriferus ejusdem aetatis evolutus est; folia erecta vel incurva, teretia obtusa, pallide glauce viridia, papillis rotundis, ad 1·1 cm. longa, 1·5—2 mm. diam.; pedunculi a receptaculo distincti, 1·2—2 cm. longi; receptaculum subglobose obconicum, ad 3 mm. longum, ad 5 mm. diam.; sepala 5, oblonga obtusa, omnia ± marginata, 3—4 mm. longa, basi 1·5—2 mm. lata; petala 2—3-seriata, sat laxa, e supra medium inferne angustata, obtusa vel subtruncata obscureque emarginata, laete rosea, 7—10 mm. longa, ad 1·5 mm. lata; staminodia nulla; filamenta ca. 4-seriata, fere erecta, rosea, ad 4 mm. longa, interiora parum supra basim conspicue roseo longeque papillata, antheris pollineque luteis; glandulae crenulatae; ovarii lobi stellate patentes, glandulas attingentes, obtuse compressi, leviter elevati; stigmata 5, e basi anguste subulata papillataque longe caudate attenuata, ad 4·5 mm. longa; capsula obtusissime 5-angulata, infra scutelliformis, 1 mm. longa, supra per 1 mm. elevata, suturis leviter compressis, 6 mm., expansa 10 mm., diam., loculis tuberculo placentale onustis (itaque nomen), aliter generis.

Cape Province: in dit. Worcester; Rabiesberg, Sept. 1935, *E. Esterhysen*. Bolus Herbarium 21630.

Described from dried specimens and dissections made from living flowers, and an excellent coloured plate with magnified dissections made by Miss B. O. Carter from the living wild plant.

Ruschia holensis L. Bol. sp. nov.—Plantae ferae 2 visae, erectae glabrae, sat rigidae, 19 et 21 cm. altae, ad 25 cm. diam.; caulis 8—10 mm. diam.; rami primarii ad 5 mm. diam., internodiis 1—2·5 cm. longis; ramuli floriferi ultimi cum floribus 4—7 cm. longi, internodiis 1—1·5 cm. longis, ad 2 mm. diam.; ramuli steriles 2—4-foliati, inferne reliquiis crebris vestiti; folia ascendentia, supra visa plana vel apicem versus convexula, superne non, vel leviter, angustata, obtusa, lat. visa apice rotundo, carina ad lineam reducta, lateribus convexulis, levia viridia, cum aetate rubra, 1—1·8 cm. longa, 4—5 mm. lata, 5—6 mm. diam.; flores 1—3-nati, meridiani; pedunculi a receptaculo bene distincti leviterque intrusi, omnes bracteati, infra bracteas compressi, supra eas teretes, 1—1·7 cm., fructiferi 2—5 cm., longi; bracteae basim vel medium receptaculi attingentes, cucullatae, lat. visae obtusae, 5—7 mm. longae cum vagina ad 4 mm. longa; receptaculum semiglobum, basi subtruncatum, 3—4 mm. longum, 5—6 mm. diam.; sepala 5 vel in flore unico (cum stigmatibus) 4, omnia ± anguste marginata, e parum supra basim superne angustata, acuta, apice interiorum breviter subulato, 6—7 mm. longa, basi 3—4 mm. lata, vel in floribus aliis superne vix angustata, abrupte acuta, 4—5 mm. et 5—6 mm. longa; petala 28—33, 2—3-seriata, e parum supra medium inferne angustata, obtusa vel subtruncata, purpureo rosea, inconspicue vittata, in flore maximo ad 1·5 cm. longa, 2 mm. lata, in aliis 10—12 mm. et 8—10 mm. longa, ad 1·5 mm. lata; staminodia nulla; filamenta 5-seriata erecta, mox diffusa exterioraque late recurva, inferne pallida, superne laete rubida, ad 4 mm., vel rarius ad 5 mm., longa, intimis parum supra medium papillatis, antheris pollineque albis; discus denticulatus; ovarium circa marginem concavum, lobis subapproximatis, superne obtuse leviterque compressis, demum ad 1 mm. elevatis; stigmata 5, gracilia, superne attenuata, brevissime papillata caudataque, pallide viridia, 4—5 mm. longa; capsula infra semiglobosa, basi subtruncata, 3—4 mm. longa, 7—8 mm., expansa ad 1·4 cm., diam., supra per 3—4 mm. elevata, suturis leviter compressis, valvis late patentibus, carinis erectis muticis brevissimis, partem tertiam valvae tantum attingentibus, in dimidio inferiore parallelis contiguis, in superiore late divergentibus, tuberculo ovale brunneo, seminibus globose obovatis, levibus.

Cape Province: in dit. Vanrhynsdorp; Hol River, prope Lutzville, Sept. 1964, *H. Hall* 2864. "Few plants seen, very widely scattered."

Ruschia defecta L. Bol. sp. nov. (*Microphyllae*).—Planta 1 visa, glabra, 13 cm. alta, 15 cm. diam., caule 5 mm. diam.; rami hornotini steriles ad 14 foliati, basi reliquiis vaginantibus paucis onusta, ad 8 cm. longi, internodiis 5—15 mm. longis, foliis omnibus simillimis, supra visis lanceolate linearibus, obtusis vel subacutis, viridibus, ad 1·1 cm. longis cum vagina 1·5 mm. longa, 2—3 mm. latis, lat. visis obtusis vel subacutis, ad 2 mm. diam., novellis apiculatis, marginibus carinaque ciliolatis; folia cetera persistentia subindurata variabilia, late ovata obtusa, ad 3 mm. longa, vel ovata acuta, ad 5 mm. longa, vel ad 7 mm. longa cum vagina pergamentacea 3 mm. longa; ramuli ultimi floriferi e paribus foliorum 1—2 et bracteis compositi, 1·5—3·5 cm. longi; pedunculi saepius 1—1·5 cm. longi, prope basim bracteati; bracteae supra visae oblonge ovatae, acutae vel subobtusae, 6—7 mm. longae cum vagina ad 2 mm. longa; receptaculum obconicum, 2 mm. longum, 3—4 mm. diam.; sepala 5, oblonga vel lineare oblonga, subacuta, omnia ± marginata, 4—5 mm. longa, basi ad 1·75 mm. lata; petala 2—3-seriata, e infra medium et prope apicem leviter angustata, 5—7 mm. longa, 0·5—0·75 mm., vel rarius ad 1 mm., lata; staminodia nulla (itaque nomen *defecta*); filamenta 3-seriata, conferta, massa parum supra basim leviter constricta, basim versus pallida, deinde sordide purpurea, intima parum supra basim papillata, antheris pollineque albis; ovarii lobi subapproximati, discum crenulatum attingentes et eum leviter excedens; stigmata 5, e basi angustissime subulata longe attenuata, sordide purpurea, 3—4 mm. longa.

Cape Province: Namaqualand; "about 17 miles from Springbok along the road to Spektakel, collected in 1963", *P. van Heerde*. Bolus Herbarium 27654. Flor. hort. van Heerde Aug. 1964.

Ruschia menniei L. Bol. sp. nov. (*Microphyllae*).—Rami primarii plures tantum conservati, e basi ad 4 mm. diam. ramulos breves crebros steriles et floriferos ad 10-foliatos, per 8 cm. elongatos, internodiis 1—1·7 cm. longis, ad 2 mm. diam., emittentes; folia omnia simillima, matura ascendentia, dimidio superiore saepe recurvo, supra visa linearia, e parum supra basim superne angustata, acuta, longe apiculata, marginibus carinaque minute cartilagineo ciliolatis, ad 1·5 cm. longa, basi 2 mm. lata, medio ad 1·5 mm. diam.; pedunculi ultra folia suprema per 1—1·5 cm. producti; receptaculum obconicum, ad 2·5 mm. longum, apice 4 mm. diam.; sepala 5, fere e basi angustata, acuminata apiculata, omnia ± marginata, 5—7 mm., vel in flore altero 6—8 mm., longa, basi 2—4 mm. lata; petala ca. 3-seriata, e parum supra medium inferne leviter angustata, acuta vel obtusa, supra rosea, externe partim vel omnino purpurea, 4—8 mm. longa, 0·5—1 mm. lata; staminodia sat pauca, gracillima, inferne pallida, superne purpurea, apice alba, stamina conferta aequantia vel leviter excedentia; filamenta 4-seriata, inferne pallida, superne purpurea, intima parum supra medium papillata, antheris pollineque albis; ovarii lobi obtuse compressi, fere per 1 mm. elevati; stigmata 5, inferne anguste subulata, longe attenuata, ad 3·5 mm. longa.

Cape Province: in dit. Malmesbury; prope Darling, Dec. 1937, *A. Mennie*. Bolus Herbarium 27660. Fl. hort. F. Bolus, July 1938.

The genus **Argyroderma** may be divided roughly into the following groups and subgroups. (It is hoped that this may assist collectors to make more valuable field-notes, and at the same time test the validity of the key.)

KEY TO THE GROUPS AND SUBGROUPS.

1. Peduncle short; bracts usually embracing or partly embracing the receptacle	EUARGYRODERMA
2. Plants 4—6-leaved	PLURIFOLIATA
2. Plants 2-leaved	BIFOLIATA
3. Plants composed of one body (i.e. the annual growth comprising one branch)	SINGULA
4. Petals rose or very rarely white	ROSEA
4. Petals yellow	LUTEA
3. Plants with age composed of more than one body (i.e. annual growth comprising two branches)	PLURIMA
5. Petals rose	ROSEA
5. Petals yellow	LUTEA
1. Peduncle elongated; bracts not embracing the receptacle	ROODIA

Argyroderma latifolium L. Bol. sp. nov. (*Euargyroderma—Bifoliata—Singula—Rosea*).—Ad **A. planum** affine, sed divergio foliorum minus, carina minus conspicua, sepalis angustioribus, petalis angustioribus inferneque magis attenuatis, saturate roseis, et filamentis brevioribus differt.

Plantae floriferae 23 visae, pallide glauce virides, 3·5—4·5 cm. diam.; folia ascendentia, ad per 1·4 cm. divergentia, pagina superiore transverse elliptica, supra medium convexula, pustula subnulla, 1·6—2 cm. longa cum vagina ad 1·4 cm. longa, 3·2—3·7 cm. lata, apice fere semicirculare, ad 2 cm. diam., late rotunde in dorsum transeunte; pedunculi 3—6 mm. longi; bracteae compressae, inferne acute, superne obtuse, carinatae, lat. visae oblique rotundae vel subtruncatae, dimidium receptaculi vel ultra attingentes, 1·5—2 cm. longae cum vagina 5—7 mm. longa; receptaculum subcompressum, 1·5 et 1·1 cm. diam., 1 cm. longum cum tubo 6 mm. longo, altitudinem foliorum attingens; sepala 6—7, omnia ± marginata, ad 4 mm. longa, basi 5—7 mm. lata; petala dense ca. 8-seriata, 4, 5, 6, 8, 9, 10, 12, 15 mm., vel in flore maximo ad 17 mm., longa, ad 1·25 mm. lata, e parum supra medium inferne angustata, basi ad 0·5 mm. lata, obtusa vel subtruncata, rarius emarginata, pulchre rosea; filamenta saepius ad 2 mm. longa, exteriora erecta, interiora deflexa dimidiumque tubi receptaculi rarius fere attingentia, alba, antheris pollineque albidis; discus denticulatus; pulvinus stigmatiferus ad 3 mm. diam., vix elevatus.

Cape Province: in dit. Vanrhynsdorp; "12 miles N. of Sout Rivier", Maio 1964, *H. Hall* 2751. N. B. G. 230/64. Fl. Jun. 1964.

Argyroderma rooipanense L. Bol. sp. nov. (*Euargyroderma—Bifoliata—Singula—Rosea*).—Plantae 2 visae; folia ascendentia, per 1·6 cm. et 2·1 cm. divergentia, pagina superiore fere ovale, 2·2 cm. longa, 2·4 cm. lata, vel subrhomboideum, apice fere rotundo, 2·2 cm. longa, medio 2·9 cm. lato, vaginis 1·3—1·4 cm. longis, pustula inconspicua, apice truncato, obscure carinato, 1 cm. et 1·2 cm. diam., rotunde in dorsum rotundatum transeunte, basi 4—7 mm. diam.; pedunculi teretes, ad 4 mm. longi; bracteae inter maximas in genere, 2—2·4 cm. longae cum vagina 1·2 cm. longa, lat. visae rotunde truncatae, ad 1 cm. diam.; receptaculum apud apicem ovarii discumque leviter constrictum, 1·4 et 1·7 cm. longum cum tubo 4 mm. et 6 mm. longo, apice ad 1·2 cm. diam.; sepala 6, omnia ± marginata, obtusa, 5—6 mm. et 6—7 mm. longa, basi 5—7 mm. et 6—8 mm. lata; petala exteriora sat laxa, ca. 3-seriata, saepe e infra medium inferne angustata, truncata, obscure emarginata, saturate purpureo rubra, ad 1·6 cm. et 1·8 cm. longa, ad 1·75 mm. et 2 mm., basi ad 1 mm., lata, interiora perpauca, 3—6 mm. longa, ad 0·75 mm. lata; stamina exteriora patentia vel ascendentia, interiora deflexa, basim tubi attingentia, filamentis albis, 2—5 mm. longis, antheris pollineque pallidissime citrinis; discus profunde crenulatus; pulvinus stigmatiferus 3 mm. diam.

Cape Province: in dit. Vanrhynsdorp; "on the farm 'Rooipan' at the eastern edge of the Knersvlakte, in decomposed slate", *P. A. B. van Breda* 1898/63. Fl. Veld Reserve, Worcester, Jun. 1964. "Out of about 50 plants I have only 1 with 2 bodies." (*van Breda*).

Argyroderma boreale L. Bol. sp. nov. (*Euargyroderma—Bifoliata—Plurima—Rosea*).—Plantae 2 visae; folia per 1·5 cm. divergentia, ascendentia, pagina superiore oblique ovale ob latus alterum quasi digito impressum, pustula obscura, parum infra medium laminae attingente, 2·7 cm. longa cum vagina 9 et 10 mm. longa, basi laminae 2 cm. lata, apice plano vel convexulo, in dorsum rotunde transeunte, ad 1·4 cm., prope basim 4 mm., diam., carina inconspicua obtusa obliquissima; pedunculi teretes, ad 7 mm. longi; bracteae dimidium tubi receptaculi attingentes, apice oblique truncato, in dorsum rotunde transeunte, 1·7 cm. longae cum vagina 6 mm. longa; receptaculum in siccis brunneum, rubre glanduliferum, ad 1·2 cm. longum cum tubo 4—5 mm. longo, ad 1·2 cm. diam., apice ovarii 9 mm. diam.; sepala 6, inter minima in genere, 3—4 mm. longa, basi ad 5 mm. lata, omnia ± marginata, apice interiorum breviter subulato; petala ca. 6-seriata, sat laxa, e prope medium inferne angustata, apice saepius truncato obscureque emarginato vel rarius obtuso, exteriora 8—13 mm. longa, ad 1·25 mm. lata, interiora pauca, ad 5 mm. longa, ad 0·5 mm. lata; stamina exteriora erecta vel patentia, interiora inflexa, ovarium vix attingentibus, filamentis albis, antheris pollineque stramineis; discus conspicuus, profunde divisus; pulvinus stigmatiferus vix 1·25 mm. diam.

Cape Province: in dit. Vanrhynsdorp, "10 miles N.E. of Bitterfontein, May 1960, *R. C. Littlewood.* Fl. Jun. 1960. Karoo Garden 269/60.

Note.—The type specimens of all new species described in this paper are in the Bolus Herbarium, University of Cape Town.

(*To be continued*)

PROTEA GRANDICEPS: ITS HISTORY AND IDENTITY

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(With Plates XVII and XVIII)

Abstract

Part of the 1805 edition of Trattinnick's Thesaurus Botanicus has been traced in Vienna. This discovery has confirmed that the name *Protea grandiceps* is correctly applied to a species known from the Cape Peninsula and other parts of the Cape Province.

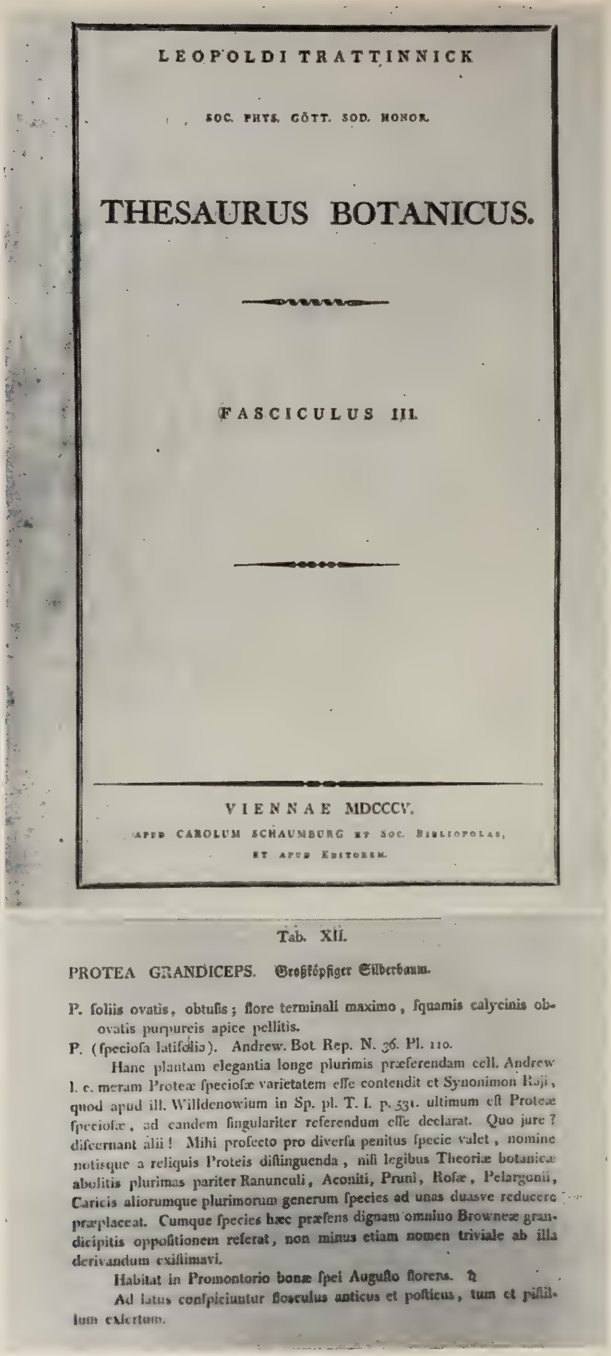
Phillips and Stapf in their account of Protea in Dyer, Flora Capensis, V, i, 562 (1912) wrote that "No copy of the first (incomplete) issue of Trattinick's Thesaurus, containing the name, description and figures of *P. grandiceps*, was accessible to us. But from the text to t. xii and the preface of the second edition, it is perfectly clear that plate xii was the same in both issues, whilst the name and the description were cancelled in the second owing to the identification of the plant with Andrews' t. 110, which had erroneously been referred to *P. speciosa*."

Efforts to trace the original description and figure by Trattinnick had for a long time been unsuccessful. According to information available in Vienna, which I visited in August 1964, Trattinnick had indeed published five parts of his Thesaurus Botanicus in 1805, containing plates 1 to 20 together with diagrams of the species. Apparently in 1805 all the 80 plates for the second edition which was printed in 1819 had been prepared but not published.

A thorough search in Vienna was made for the 1805 edition in the Natural History Museum, the National Library and at the Botanical Institute of the University but it was not to be found.

It had also been hinted that a copy might be in Leningrad. I visited the Library of the V. L. Komorov Botanical Institute of the U.S.S.R. Academy of Sciences in that city where only the second edition was traced.

In the 1819 edition of his Thesaurus Botanicus, published in Vienna, Trattinnick named the species *Protea speciosa* L. and stated that it was the same as his *P. grandiceps* of the first edition of that work: "Haec est Pr. grandiceps 1 $^{\text{mae}}$ ed. h.o. sine dubio non minus a praecedenti, quam etiam a *P. scabrida* Thunb. specie diversa."



LEOPOLDI TRATTINNICK

SOC. PHYS. GÖTT. SOD. HONOR.

THESAURUS BOTANICUS.

FASCICULUS III.

VIENNAE MDCCCV.
APUD CAROLUM SCHAUMBURG ET SOC. BIBLIOPOLAS,
ET APUD EDITOREM.

Tab. XII.

PROTEA GRANDICEPS. Großköpfiger Silberbaum.

P. ſoliis ovatis, obtuſis; flore terminali maximo, ſquamis calycinis obovatis purpureis apice pellitis.

P. (ſpecioſa latifolia). Andrew. Bot. Rep. N. 36. Pl. 110.

Hanc plantam elegantia longe plurimis præferendam cell. Andrew l. c. meram Proteæ ſpecioſæ varietatem eſſe contendit et Synonimon Raji, quod apud ill. Willdenowium in Sp. pl. T. I. p. 531. ultimum eſt Proteæ ſpecioſæ, ad eandem ſingulariter referendum eſſe declarat. Quo jure? diſcernant alii! Mihi profecto pro diverſa penitus ſpecie valet, nomine notisque a reliquis Proteis diſtinguenda, niſi legibus Theoriæ botanicæ abolitis plurimas pariter Ranunculi, Aconiti, Pruni, Roſæ, Pelargonii, Caricis aliorumque plurimorum generum ſpecies ad unas duasve reducere præplaceat. Cumque ſpecies hæc præſens dignam omnino Browneæ grandicipitis oppoſitionem referat, non minus etiam nomen triviale ab illa derivandum exiſtimavi.

Habitat in Promontorio bonæ ſpei Auguſto florens. ♄

Ad latus conſpiciuntur floſculus anticus et poſticus, tum et piſtillum exſertum.

Plate XVII
Protea grandiceps Tratt.
Title page of the 1805 Edition of Thesaurus Botanicus fasc. III by Trattinnick, and description of *Protea grandiceps*.

P. scabrida quoted by Trattinnick and of which I have seen a specimen in Thunberg's herbarium in Uppsala, Sweden is none other than *P. lepidocarpodendron* (L.) Linn. The name and description were published by Thunberg in Hoffm. Phytogr. Blätt. 14 (1803) and again in Nova Acta Acad. Scient. Imp. Petropol. XV, 465 (1806). It differs from *P. grandiceps* by having much narrower leaves and by the dense, black, velvety tomentum near the apices of the involucral bracts. In fact, it could be far more easily confused with *P. neriifolia* R.Br. or *P. laurifolia* Thunb. than with *P. grandiceps* Tratt. (See Rycroft: Journ. S. Af. Bot., XXIV, 201, 1958.)

P. speciosa (Linn.) L. and *P. grandiceps* Tratt. although also related, are obviously different. In the former, most of the involucral bracts are bearded, the leaves are elliptic to oblong-obovate and the styles are puberulous, whereas in the latter only the innermost bracts are bearded, the leaves are obovate, obtuse and with a broad base and the styles are glabrous.

That an earlier edition of Thesaurus Botanicus by Trattinnick was published is also indicated by reference to it by Dietrich and by Maser, both of whom used the name *P. grandiceps*. Dietrich in Bollst. Lex. Gart. und Botan. VII, 535 (1807) cites "Tratt. Thes. Bot. 3, t. 12" and Maser in Allg. Teutsch. Gart. Mag. IV, 137 t. 9 (1808) cites "Trattinnick, Thes. Botan. fasc. III, tab. 4." Trattinnick's tab. xii of 1819 is exactly the same as Maser's t. 9. The only doubt, therefore, was whether the figure in Trattinnick's first work was t. iv or t. xii.

Pritzel's Thesaur. Lit. Botan. gives the date of publication of Trattinnick's first edition as 1805.

Although other names had been applied before 1807 these were all occupied by various species and therefore cannot be applied in preference to *P. grandiceps* Tratt.

It must be stressed that Trattinnick's was not the first figure of this species because it is almost identical to t. 110 of Andrew Bot. Repos. (1800) where it was given the name of *P. speciosa latifolia*. Andrews stated that "in the year 1786 it was sent, in seeds, to the royal gardens, Kew, by Mr. F. Masson from the Cape of Good Hope; where certainly its beauty must be great."

Not only was it grown in England more than one and a half centuries ago but it was also cultivated on the Continent, for Maser (1808) wrote "Dieser Prachtflanze findet man bei Hrn. Schneevogt in Haarlem, und bei Hrn. Wendland in Herrenhausen unter dem namen, *Protea speciosa latifolia*."

Robert Brown published the name *P. coccinea* for this species in 1810 and later authors such as Poiret, Roemer and Schultes, Sprengel, Steudel, Meisner and Bolus upheld the name. "*P. coccinea*" appears in many herbaria on labels attached to specimens collected by Drege, Ecklon, Zeyher, Prior and Forster.

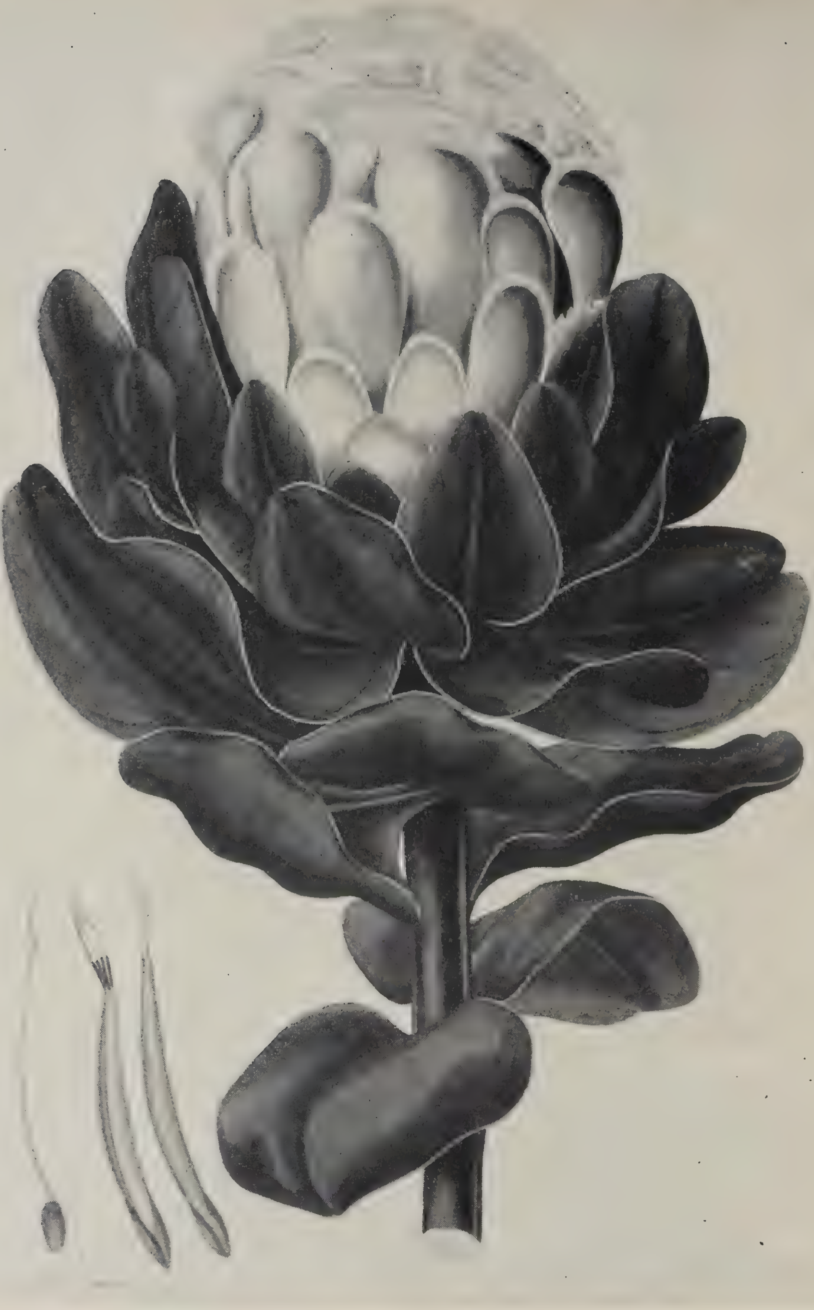


PLATE XVIII
Protea grandiceps Tratt.
Tab. xii of the 1805 Edition of Thesaurus Botanicus fasc. III by Trattinnick.
(*By courtesy of Prof. K. H. Rechinger, Natural History Museum, Vienna.*)

When the present paper was being prepared for the printers a letter was received from Professor Dr. K. H. Rechinger, First Director of the Natural History Museum in Vienna, stating that he had at last succeeded in tracing a fragmentary piece of part 3 of the 1805 edition of Thesaurus Botanicus at the Botanical Institute. Fortunately it contains the plate and diagnosis of *P. grandiceps*. Tab. xii is identical in both editions. The name can therefore be accepted without any further doubts. I am indeed very grateful to Professor Rechinger for his help in clarifying this nomenclature (see Plates xvii and xviii).

For a long time it was thought that *P. grandiceps* occurred only on Devil's Peak and that it was extremely rare. In fact, Alexander Prior wrote on sheets which are in the Herbarium of the Royal Botanic Gardens, Kew, that the last bush of it was burnt in 1847.

In a note in the Bolus Herbarium Marloth stated that from 1854 until 1916 it had not been observed on the Cape Peninsula: "Found during the year 1916 on the Devil's Peak (small patch) and Table Mountain (one bush only)." On the same sheet he quoted Dr. Pappe as having stated in 1854 that "this Protea formerly adorned the sides of the Devil's Peak, but, owing to a series of bush fires, has gradually disappeared and seems now to have been altogether annihilated."

It is encouraging to know that during the last few years *P. grandiceps* has been found growing in the Worcester, Wellington, Stellenbosch, Caledon, Swellendam, Uniondale and Uitenhage areas.

The type of this species is the figure in Andrews Bot. Repos. t. 110, (1800).

SYNONYMY

PROTEA GRANDICEPS *Trattinnick* Thesaurus Botan. ed. I. fasc. iii, t. xii (1805);
Dietrich in Bollst. Lex. Gart. und Botan. vii, 535 (1807); *Maser* in Allg. Teutsch. Gart. Mag. iv, 137, t. 9 (1808); *Breit.* Hort. Breit. 381 (1817); *Kerner* Hort. Semp. xxix, t. 337 (date ?); *Phill. et Stapf.* in Dyer Fl. Cap. V, i, 561 (1912); *Bolus* First Book S. Afr. Flow. ed. II, 61 cum ic (1928); *Guthrie et Salter* in Adamson et Salter Fl. Cap. Pen. 323 (1950); *Kidd* Wild Fl. Cap. Pen. t. 3 (1950); *Luckhoff* Table Mt. t. 72 (1951); *Eliovson* S. Afr. Flow. Gard. 264 cum ic (1955); *Vogts* Prot. 51, cum. ic (1958); *Rycroft* Our Flow. Parad. 27 cum ic (1963).

P. speciosa (non Linn.) *Gawl.* in Andr. Bot. Repos. Recens. 8, nr. 31 (1801); *Sims* Bot. Mag. t. 1183 (1809); *Tratt.* Thes. Botan. ed. II, 5, t. 12 (1819).

P. speciosa latifolia *Andr.* Bot. Repos. t. 110 (1800); *Poiret* Encycl. Method. v, 646 (1804); *Persoon* Synop. Plant. 115 (1805).

P. coccinea *R. Brown* in Trans. Linn. Soc. x, 77 (1810); *Poiret* Encycl. Method. Suppl. iv, 560 (1816); *Roem. et Schult.* Syst. Veg. iii, 343 (1818); *Spreng.* Syst. Veg. i, 461 (1824); *Poiret* in Dict. Sci. Nat. xliii, 390 (1826); *Steud.* Nomencl. Bot. i, 399 (1840); *Meisn.* in DC. Prodr. xiv, 230 (1856); *Bolus* in Trans. S. Afr. Philos. Soc. xiv, 313 (1903).

P. obtusa *Sweet* Hort. Suburb. Lond. 20 (1818); *Knight ex Sweet* Hort. Brit. ed. I, 346 (1827).

P. villifera *Lindl.* in Bot. Reg. t. 1023 (1826); *Loud.* Hort. Brit. ed. I, 37 (1830). ed. II, 37 (1850); *Meisn.* in DC. Prodr. xiv, 232 (1856).

Erodendrum obtusum *Salisb. ex Knight* Prot. 39 (1809).

DISTRIBUTION

WORCESTER: Dutoitskloof, *Drege* "*P. coccinea* R. Br." (B, CGE, G, HAL, K, L, MO, P); Slanghoek Mts., Observation Peak, *Esterhuysen* 19989a (BOL, NBG, PRE).

WELLINGTON: Sneeukop, Bainskloof, *Kies* (NBG), *van der Merwe in herb. BOL* 15387 (BOL).

CAPE: Camps Bay, *Ecklon & Zeyher* 4682 "*P. coccinea* R. Br." (SAM); Devil's Peak, *Andreae in herb. Marloth* 7372 (PRE), *Ecklon* 651 (G, LE, MO, P), *Marloth* (BOL, PRE), *Niven* "*obtusum*" (holotype of *P. coccinea* R. Br.) (K), *Pappe* (PRE); *Zeyher* (?) 651 (BOL); Lion's Head, *Prior* "*P. coccinea* R. Br." (K); Table Mtn., *Marloth* 7485 "a single bush 3′ high, July 1916", 7690, 9493 (PRE); Corridor Buttress, *Stokoe* (PRE); Between Table Mtn. and Devil's Peak, *Pillans* 3345 (BOL, PRE).

STELLENBOSCH: Jonkershoek, *Rycroft* 1253 (NBG), Dwarsberg, *Rycroft* 2136 (NBG).

CALEDON: Somerset Sneeukop, *Esterhuysen* 1787 (BOL); Skilpadkop, Riviersonderend Mts. near Greyton, *Esterhuysen* 21066 (BOL); Ridge Peak, W. of Riviersonderend Peak, *Thorne in herb. SAM* 45894 (SAM).

SWELLENDAM: near Swellendam, *Burrows* (BOL); S. side of Crown Mtn., *Wurts* 333 (NBG).

UNIONDALE: Kouga Mtns., Peak E. of Smutsberg, *Esterhuysen* 7031 (BOL).

UITENHAGE: Great Winterhoek, Cockscomb, *Esterhuysen* 27138 (BOL, PRE).

WITHOUT LOCALITY: *Anderson* (S), *Drege* "*P. coccinea* R. Br." (G, L, LE, MO, P), *Forster* "*P. cotinifolia*" (K).

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Kirstenbosch, Newlands, Cape Province

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DIRECTOR OF THE NATIONAL BOTANIC GARDENS OF SOUTH AFRICA
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NATIONAL BOTANIC GARDENS OF SOUTH AFRICA

The National Botanic Gardens were established in 1913 by unanimous resolution of the Parliament of the Union of South Africa; Kirstenbosch, part of the Groote Schuur Estate at Cape Town bequeathed to the nation by Cecil Rhodes, being chosen as the site and reserved by the Union Government for this purpose.

The Upper Kirstenbosch Nature Reserve, Table Mountain, was placed under the same control in 1922 for the better protection of the native vegetation.

The Karoo Garden at Whitehill was established by private benefaction in 1921. A new site was given by the Worcester Municipality in 1945 and the work was transferred there in 1946.

The Harold Porter Botanic Reserve at Betty's Bay was bequeathed by the late Harold Nixon Porter and placed under the control of the National Botanic Gardens of South Africa in 1959.

The Darling Flora Reserve and the Cape Flats Flora Reserve were acquired by private donation in 1957.

The Gardens are controlled by a Board of Trustees appointed by the Government, the Botanical Society of South Africa, the Cape Provincial Administration, the Cape Town City Council, the South African Railways and the University of Cape Town. The Director is one of the Professors of Botany in the University of Cape Town and is appointed jointly by the University and the Trustees.

The funds of the Gardens are derived from (1) grants made by the Government, the S.A. Railways, the Cape Town Corporation, the Cape Provincial Council, the Cape Divisional Council, the University of Cape Town and the Worcester Municipality; (2) private benefactions, either direct or through the Botanical Society; (3) sales and miscellaneous.

The primary objects of the Gardens are scientific and educational; the collection, cultivation, study and display of the indigenous flora of South Africa; the preservation of the native vegetation of South Africa.

Kirstenbosch, the Karoo Garden, the Harold Porter Botanic Reserve, and the Darling Flora Reserve are open to the public during daylight every day of the year. The Cape Flats Flora Reserve may be visited with permission from the Director.

BOTANICAL SOCIETY OF SOUTH AFRICA

The Society, founded in 1913, and now consisting of over 3,500 subscribing members in all parts of South Africa and in other countries, exists primarily to give general and financial support to the work of Kirstenbosch and Worcester. The whole of its annual income, after paying expenses, is granted to the Trustees of the Gardens for current expenditure; and the sums accumulating in its fund from the subscriptions of life members are also granted to the Trustees for special pieces of development. Members of the Botanical Society enjoy certain privileges which include participation in the scheme of free distribution of surplus seed from Kirstenbosch and the Karoo Garden.

The President of the Botanical Society is Mr. Dudley R. D'Ewes; the Vice-Presidents are Mr. C. J. Sibbett, Professor H. B. Rycroft and Professor R. H. Compton, and there is a council of fifteen.

The membership subscriptions are as follows: *Benefactors*, R1,000.00; *Patrons*, R200.00; *Life*, R50.00; *Corporate*, R10.00 p.a.; *Family*, R5.00 p.a.; *Ordinary*, R3.00 p.a. Additional subscriptions are payable voluntarily in support of the Wild Flowers Protection Section of the Society. The Secretary and Treasurer of the Botanical Society of South Africa, Kirstenbosch, Newlands, C.P., will supply full information and applications for enrolment should be addressed to her.

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JOURNAL OF SOUTH AFRICAN BOTANY

The Trustees of the National Botanic Gardens of South Africa have undertaken responsibility for the publication of the JOURNAL OF SOUTH AFRICAN BOTANY. This periodical publishes contributions embodying the results of botanical research in any of the various branches of the science. It provides a medium for the publication of work on the South African flora whether systematic, ecological, morphological or otherwise, and whether carried out in South Africa or in other countries; and also on botanical subjects of special interest and application in South Africa.

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HEDYSAREAE, SUBTRIBE STYLOSANTHINAE (LEGUMINOSAE), IN AFRICA AND MADAGASCAR

Robert H. Mohlenbrock
(Southern Illinois University)

ABSTRACT

This paper endeavours to give a taxonomic account of the species of subtribe Stylosanthinae, tribe Hedysareae, of the papilionaceous Leguminosae in Africa and Madagascar. The bibliography, while not intended to be complete, includes most of the major floristics works concerning Africa and Madagascar.

Five genera comprise the Stylosanthinae, of which *Stylosanthes* and *Zornia* occur naturally in Africa while *Arachis* is cultivated frequently. The monotypic genera *Chapmannia* and *Pachycoa* are confined to limited areas in North America. *Arachis* occurs naturally only in Brazil and Paraguay.

BRIEF HISTORICAL ACCOUNT

One of the first studies on the African flora was that by Thunberg in 1800 in his Prodromus Plantarum Capensium. Thunberg listed only one species in our group, *Hedysarum tetraphyllum*, which is actually *Zornia capensis*, the common species of the Cape Province. Thunberg in 1823 published Flora Capensis, and this was followed by Guillemin, Perottet, and A. Richard's work on Senegambia (1830), Hooker's Niger Flora (1848), Harvey and Sonder's study of the Cape flora (1861), and Oliver's Flora of Tropical Africa (1871). Each of these works was prepared rather carefully, although none of the authors was apparently aware of the confusion in the binomial *Zornia diphylla*. Of the early workers, only A. Richard (1847) recognized Reichenbach's *Zornia glochidiata* as the most widely distributed species in Africa.

During the first half of the twentieth century, the floras followed very closely the earlier works of Hooker, Harvey and Sonder, and Oliver. Hutchinson and Dalziel's fine work on the Flora of West Tropical Africa (1927) listed six species of the Stylosanthinae, three of which are no longer recognized. Other works which should be mentioned are Drake's (1902) and Palacky's (1907) studies in Madagascar, Marloth's "The Flora of South Africa" (1925), and the floras of Sudan (Broun and Massey, 1929), Gold Coast (Irvine, 1930), Somaliland (Chiovenda, 1932), and Senegal (Trochain, 1940).

E. G. Baker's "The Leguminosae of Tropical Africa" (1929) brought together most of the previous data on the legumes of Africa. In the Stylosanthinae, Baker listed eleven species and four varieties, of which seven of the species are recognized in the present study. Baker, likewise, continued to carry the binomial *Zornia diphylla*.

Milne-Redhead, whose studies early in the 1950's began to unravel the problems of the genus *Zornia* in Africa, culminated his work with the publication of "The Zorniae of Tropical Africa" (1954). His work has enabled the most recent floras to become better aligned on the Stylosanthinae. Included in these works are those by Andrews (1952), Keay (1954), Robyns, *et al.* (1954), and Cufodontis (1955).

The writer's study in this group has resulted in a few alterations and the describing of three new African Zorniae (1958, 1960, 1961, 1961a).

KEY TO THE AFRICAN AND MADAGASCAN GENERA OF STYLOSANTHINAE

1. Leaves imparipinnate (leaflets 3).
    2. Loment with 1—2 articles; bracts borne singly .. .. .. 1. *Stylosanthes*
    2. Loment with 3—several articles; bracts borne in pairs .. .. 2. *Zornia reptans*

1. Leaves paripinnate (leaflets 2 or 4).
    3. Receptacle of flower sessile; loment with 2—8 articles, developing above the ground; stipules free from the petioles .. .. .. 2. *Zornia*
    3. Receptacle of flower much elongated; loment without distinct articulations, developing below the ground; stipules fused at base with the petioles .. .. 3. *Arachis*

1. STYLOSANTHES Sw. Prod. Veg. Ind. Occ. 108. 1788.

Herbs, rarely subshrubs. Leaves pinnately 3-foliolate; stipules amplexicaul, divided at the apex into two teeth, adnate to the base of the petioles; stipels none. Inflorescence spicate, terminal or axillary, 1- to several-flowered; flowers yellow or orange with purple stripes; calyx 5-lobed and with a long tube; corolla

5-merous, papilionaceous; stamens 10, the filaments united into a tube which splits with age, with 5 versatile anthers alternating with 5 sub-basifixed anthers; fruit a 1- to 2-articulated loment; seeds ovoid, light brown to black, smooth, lustrous.

Twenty-nine species of tropical and subtropical regions. Four species occur in Africa and Madagascar, one of which is adventive.

KEY TO THE AFRICAN AND MADAGASCAN SPECIES OF STYLOSANTHES

1. Each flower, or at least the lower flowers, subtended by an axis rudiment; inner bracteoles 2.
  2. Loment glabrous, or pubescent only on the beak; stems glabrous or puberulent, rarely with bristles .. .. 1. *S. erecta*
  2. Loment pubescent on the body as well as on the beak; stems frequently bearing bristles .. .. 2. *S. mucronata*

1. Flowers not subtended by an axis rudiment; inner bracteole 1.
  3. Stems covered with viscid hairs; beak about one-half as long as fertile articulation .. .. 3. *S. viscosa*
  3. Stems glabrous or puberulent, but never viscid; beak about equalling the fertile articulation .. .. 4. *S. suborbiculata*

1. **Stylosanthes erecta** Beauv. Fl. Owar. 2 : 28. 1807; Guillemin, Perottet, & Richard (1830) 204; Oliver (1871) 156; Hiern (1896) 238; Durand & Schinz (1896) 108; DeWildeman (1910) 207; DeWildeman (1914) 125; DeWildeman (1925) 386; Hutchinson & Dalziel (1927) 413; Baker (1929) 319; Irvine (1930) 400; Trochain (1940) 384; Keay (1954) 575; Robyns (1954) 347; Mohlenbrock (1957) 314.

Stylosanthes guineensis Schum. in Schum. & Thonn. Beskr. Guin. Pl. 357. 1828.

Ononis coriifolia Reichb. ex Guil., Perr. & Rich. Pl. Senegam. 204. 1830, nom. nud. in synon.

Stylosanthes guineensis G. Don, Gen. Syst. 2 : 281. 1832; Hooker (1848) 301; Hutchinson & Dalziel (1927) 413.

Stylosanthes erecta var. *guineensis* Vog. in Linnaea 12 : 68. 1838; Baker (1929) 320.

Stylosanthes erecta var. *acuminata* Welw. ex Baker in Oliver, Fl. Trop. Afr. 2 : 156. 1871; Hiern (1896) 238; Baker (1929) 320.

Stems suffrutescent, suberect, 0·3—1·5 m. tall, much branched, puberulent above, glabrous below, rarely with bristles. Leaflets oblanceolate, mucronulate, narrowed at both ends, glabrous, often punctate beneath, usually with 2—5 pairs of conspicuous veins; terminal leaflet to 25 mm. long and 5·5 mm. broad, the lateral ones to 13 mm. long and 4·5 mm. broad; petioles 4—6 mm. long, glabrous or puberulent, the rhachis about 1·5 mm. long; sheath of the stipules 4·0—7·5 mm. long, glabrous, puberulent, ciliate, or bristly, 5- to many-nerved, the teeth 3·5—5·0 mm. long. Spikes oblongoid to narrowly elongate and sometimes interrupted, 4- to 12-flowered; bracts usually unifoliolate, the leaflet averaging 6 mm. long, the sheath 4—6 mm. long,4·0—5·5 mm. broad, ciliate along the margins and often bristly on the back, 5- to 7-nerved, the teeth 2·5—4·5 mm. long; outer bracteole 1, 3—6 mm. long, ciliate at the apex; axis rudiment 3·5—6·5 mm. long, ciliate; inner bracteoles 2, 2·0—3·5 mm. long. Calyx tube 4·0—5·5 mm. long, the lobes about 2 mm. long. Standard suborbiculate, 4·0—6·5 mm. long; wings 4—5 mm. long, auriculate, clawed; keel petals falcate, 3·5—4·5 mm. long. Loment 1·5—2·0 mm. wide, reticulate and with one longitudinal nerve per face; only the upper articulation usually fertile, 3·5—4·5 mm. long, glabrous or nearly so; beak uncinate, glabrous or short-hairy on the inner face, 1·5—2·5 mm. long, less than half as long as the upper articulation.

Dry, gravelly hills, sea sands, sandy pastures, and sandy thickets along rivers.

Angola, Belgian Congo, Gaboon, Gold Coast, Ivory Coast, Liberia, Nigeria, Senegambia, Sierra Leone.

2. **Stylosanthes mucronata** Willd. Sp. Pl. 3 : 1166. 1800; Oliver (1871) 157; Engler (1895) 216; Hiern (1896) 239; Wood (1908) 148; Talbot (1909) 309; Friss (1914) 89; Bews (1921) 111; Baker f. (1929) 320; Obermeyer, Schweickerdt, & Verdoorn (1937) 239; Hutchinson (1946) 665; Lebrun, Taton, & Toussaint (1948) 76; Keay (1954) 575; Robyns (1954) 348; Mohlenbrock (1960) 341.

Stylosanthes bojeri Vog. in Linnaea 12 : 68. 1838; Peters (1862) 43; Oliver (1871) 157; Engler (1894) 85; Engler (1895) 216; Drake (1902) 164; Palacky (1907) 80; Harms (1911) 260; Baker f. (1929) 321; Chiovenda (1932) 165.

Stylosanthes setosa Harv. in Harv. & Sond. Fl. Cap. 2 : 227. 1862; Marloth (1925) 68.

Stylosanthes flavicans Baker in Oliv. Fl. Trop. Afr. 2 : 156. 1871; Baker (1929) 320; Broun & Massey (1929) 195; Andrews (1952) 234; Cufodontis (1955) 296.

Stylosanthes viscosa sensu Hutchinson & Dalziel (1927) 413; Irvine (1930) 300; Trochain (1940) 384.—Non Sw. (1788).

Stylosanthes fruticosa sensu Cufodontis (1955) 296; Mohlenbrock (1957) 318.—Non (Retz.) Alst.

Stem suffrutescent, about 5 dm. tall, much branched, erect or spreading, sometimes prostrate, shortly white-hairy above, occasionally with scattered short bristles, these sometimes yellow, often puberulent or glabrescent below. Leaflets acute, rarely obtuse at the tip, glabrous or puberulent to densely short-hairy, often with scattered short setae on the margins and midvein beneath, with 3—4 pairs of conspicuous nerves, or with the veins rarely obscure; terminal leaflet to 17 mm. long (rarely to 25 mm. long) and 3·0—4·5 mm. broad (rarely to 8 mm. broad), the lateral to 16 mm. long and 3·0—4·5 mm. broad; petioles 4—7 mm. long, hispidulous or shortly bristly, sometimes puberulent, the rhachis 1·0—2·5 mm. long; sheath of the stipules 4·5—10·0 mm. long, densely and shortly hairy and usually with scattered bristles, or sometimes only with bristles, with 5—7 pairs of conspicuous nerves, the subulate teeth 3—6 mm. long, never longer than the sheath. Spikes ovoid, dense, 4- to 10-flowered; bracts mostly unifoliolate, the leaflet(s) often plicate, the sheath tuberculate-bristly to nearly long-ciliate around the margins, 3·0—6·5 mm. long, 2·5—5·5 mm. broad, about 7-nerved, the teeth averaging 3—5 mm. long, often nearly equalling the sheath; outer bracteole 1, 4—6 mm. long, ciliate at the apex; axis rudiment 3—5 mm. long, ciliate; inner bracteoles 2, 2·5—4·5 mm. long, ciliate at the apex. Calyx tube 4·5—6·5 mm. long, the lobes 2—4 mm. long, ciliate. Standard suborbiculate, 4·5—7·0 mm. long; wings 4—5 mm. long, auriculate at the base; keel petals 4—5 mm. long, auriculate. Loment 1·5—2·5 mm. broad, reticulate; both articulations usually fertile, or the lower sometimes abortive; lower articulation, when fertile, 2·5—4·0 mm. long and as long as or slightly longer than the upper, pilose; beak somewhat uncinate or scarcely coiled, 1·5—3·0 mm. long, shortly hairy.

This species is very diverse in its morphology, but no variation appears to be very constant.

Kenya, Madagascar, Mozambique, Nigeria, Southern Rhodesia, Sudan, Tanganyika, Transvaal, Zululand.

3. **Stylosanthes viscosa** Sw. in Prod. Veg. Ind. Occ. 108. 1788; Hooker (1848) 301; Oliver (1871) 156; Baker f. (1929) 321; Mohlenbrock (1957) 341.

Stems ascending and spreading or prostrate and matted, much branched, to 1 m. long, densely pubescent with short viscid hairs. Leaflets to 25 mm. long, 5 mm. broad, usually much smaller, acute or obtuse, punctate beneath, shortly hairy or hispidulous, with 2—4 pairs of conspicuous veins; petioles 2·5—5·0 mm. long, hispidulous, viscid, the rhachis 1—2 mm. long; sheath of the stipules 3·5—5·5 mm. long, 1—2 mm. longer than the teeth, hispidulous and viscid on the back, 3- to 5-nerved. Spikes small, crowded, ovoid, 2- to 5-flowered; outer bracts usually trifoliolate, inner unifoliolate, the sheath equalling or slightly exceeding the teeth, hispidulous and viscid on the back, 5- to 7-nerved; outer bracteole 1, 2·5—3·0 mm. long, ciliate at the apex; axis rudiment none; inner bracteole 1, 2·5—3·0 mm. long, ciliate at the apex. Calyx tube 3—7 mm. long, glabrous to puberulent. Standard suborbiculate, 4—7 mm. long; wings 4—5 mm. long, auriculate, spurred within at the base; keel petals 3—4 mm. long, falcate. Loment to 2·5 mm. broad; only the upper articulation of the loment fertile, 2—4 mm. long, shortly hairy, reticulate-nerved; beak short, less than half as long as the upper articulation, usually about one-third to one-fourth as long, shortly hairy, strongly uncinate, often coiled.

Adventive from South America in Sierra Leone. Most reports of this species from Africa are based on *S. mucronata*.

4. **Stylosanthes suborbiculata** Chiov. in Ann. di Bot. 13 : 381. 1915; Baker f. (1929) 321; Cufodontis (1955) 297; Mohlenbrock (1957) 347; Mohlenbrock (1960) 342.

Stems herbaceous to somewhat woody at the base, much branched, spreading to suberect, to 40 cm. long, glabrous or puberulent, at least when young. Leaflets suborbicular, obtuse to slightly retuse at the apex, the terminal to 6 mm. long and 5 mm. broad, the lateral slightly smaller, glabrous on both surfaces, with 3—4 pairs of prominent veins; petioles 3—5 mm. long, glabrous to puberulent, the rhachis 1—2 mm. long; stipular sheaths 5—8 mm. long, 3- to 5-nerved, sparsely setose, the subulate teeth 2—4 mm. long. Spikes narrow, 5—8 mm. long, 2- to 5-flowered; outer bracts trifoliolate, inner bracts unifoliolate, the sheaths stipuliform; outer bracteole 1, 2·5—3·0 mm. long, ciliate near the tip; axis rudiment none; inner bracteole 1, 2·0—2·5 mm. long, ciliate. Calyx tube 2—3 mm. long, the lobes 2—3 mm. long, ciliate. Standard suborbiculate, 4—6 mm. long; wings 3—5 mm. long, auriculate, spurred within at the base; keel petals 3—4 mm. long, falcate. Loment faintly reticulate, 2·0—2·5 mm. broad; only the upper articulation of the loment fertile, 2·5—3·0 mm. long, glabrous; beak uncinate or nearly circinate, 2·5—3·0 mm. long.

Somaliland.

2. ZORNIA J. Gmel. Syst. 1076. 1791.

Herbs, rarely subshrubs. Leaves bi- to quadri-foliolate; stipules peltate, paired; stipels none. Inflorescence spicate, rarely racemose, terminal or axillary, 1- to several-flowered; bracts peltate, paired; flowers yellow, orange-yellow, or rarely white; calyx 5-lobed, with a short tube; corolla 5-merous, papilionaceous; stamens 10, the filaments united into a tube which abscisses about half its length at maturity, with 5 versatile anthers alternating with 5 subbasifixed anthers; fruit a 2- to 15-articulated loment; seeds ovoid, black or dark brown, estrophiolate.

Seventy-five species of tropical and subtropical regions. Sixteen species occur in Africa and Madagascar.

KEY TO THE AFRICAN AND MADAGASCAN SPECIES OF ZORNIA

1. Leaflets 4.
  2. Loment 2·7—3·5 mm. long, 2·5—3·3 mm. broad; bracts ovate to lance-ovate, acute .. .. *Z. milneana*
  2. Loment 1·2—2·5 (—2·8) mm. long, 1·2—2·5 mm. broad; bracts various.
    3. Leaves filiform or linear .. .. 2. *Z. linearis*
    3. Leaves narrowly lanceolate to very broad.

4. Bristles of loment 2·5—3·5 mm. long .. .. .. 3. *Z. setosa*
4. Bristles of loment to 1·0 mm. long, or lacking.
5. Leaflets obovate; stems pilose; bristles of loment usually glabrous .. .. 4. *Z. obovata*
5. Leaflets narrowly lanceolate to oblanceolate; stems glabrous; bristles (when present) of loments pubescent.
6. Loments with numerous bristles, ereticulate .. 5. *Z. tropica*
6. Loments bristleless, or with a very few short, peripheral bristles, usually reticulate .. .. 6. *Z. capensis*
1. Leaflets 2 (rarely also 3 or 4 in *Z. reptans*).
7. Lower and upper leaflets essentially the same shape, although the upper are frequently smaller.
8. Loments without bristles, or with a few bristles 0·1 mm. long; inflorescence congested (becoming interrupted in *Z. reptans*).
9. Articles of loment with golden, sessile glands, the body glabrous .. .. 7. *Z. reptans*
9. Articles of loment eglandular, the body glabrous to puberulent .. .. 8. *Z. albolutescens*
8. Loments with numerous bristles 0·3—5·0 mm. long; inflorescence interrupted.
10. Bristles of loment 1·5—5·0 mm. long.
11. Plants essentially glabrous; leaflets and bracts usually sparsely punctate .. .. 9. *Z. setifera*
11. Plants puberulent to hirsute; leaflets and bracts usually epunctate .. .. 10. *Z. durumuensis*
10. Bristles of loment 0·3—1·0 (—1·3) mm. long .. .. 11. *Z. pratensis*
7. Lower and upper leaflets different in shape, the lower usually broader and shorter, the upper becoming lanceolate to linear.
12. Loment bristleless, or with a few peripheral bristles 0·1—0·2 mm. long.
13. Loment glabrous, exserted from the bracts .. .. 12. *Z. brevipes*
13. Loment puberulent to villous, included within the bracts 13. *Z. puberula*
12. Loment usually with numerous bristles over 0·2 mm. long.
14. Loment glabrous; plants annual .. .. 14. *Z. glochidiata*
14. Loment pubescent; plants perennial.
15. Loment included within the bracts; native species .. 15. *Z. apiculata*
15. Loment exserted from the bracts; adventive species *16.* *Z. latifolia*

1. **Zornia milneana** Mohlenbrock, Kew Bull. *15* : *325*. 1961; Mohlenbrock (1961a) 26.

Zornia bracteata sensu Hiern (1896) 240. Non [Walt.] J. Gmel. (1791).

Zornia tetraphylla sensu Baker (1929) 323, pro parte.—Non Michx. (1803).

Perennial. Stem prostrate or nearly so, to 75 cm. long, branched, punctate, glabrous to puberulent. Leaves with 4 leaflets; leaflets linear-lanceolate, rarely linear, rarely ovate, acuminate, to 40 mm. long, 5 mm. broad, punctate, glabrous, one-nerved; petiole one-fourth to one-half as long as the leaflets, punctate, puberulent; petiolule villous; stipules punctate, usually glabrous, 5- to 7-nerved. Inflorescence crowded at the tip, becoming interrupted below; bracts ovate, acuminate, to 12 mm. long, 7 mm. broad, the auricle to 3·5 mm. long, punctate, glabrous, 5- to 7-nerved; calyx to 4 mm. long, partly strigose, 5-nerved; standard to 12 mm. long. Loment with 4—5 articles; articles 2·7—3·0 (—3·5) mm. long, 2·5—2·7 (—3·0) mm. broad, with obscured reticulation, puberulent or glabrous, with numerous retrorsely hairy bristles to 0·7 mm. long, rarely to 1·0 mm. long, glandular or eglandular.

Type: *Plowes 1410*, from Southern Rhodesia. Sandy grasslands.

Angola, Bechuanaland, Mozambique, Natal, Northern Rhodesia, Southern Rhodesia, South West Africa, Transvaal.

2. **Zornia linearis** E. Mey. Comm. Pl. Afr. Austr. 122. 1834; Mohlenbrock (1961a) *39.*

Zornia tetraphylla var. *linearis* (E. Mey.) Harv. in Harv. & Sond. Fl. Cap. 2 : 225. 1861; Baker f. (1929) 324; Hutchinson (1946) 294, 357.

Perennial. Stems erect, slender, to 40 cm. tall, branched, minutely strigose, glabrous. Leaves with 4 leaflets; petiole one-fourth as long as the leaflets, glabrous; leaflets filiform, to 20 mm. long, 1 mm. broad, punctate, glabrous, one-nerved; petiolule glabrous; stipules punctate, glabrous, 5-nerved. Inflorescence interrupted; bracts lanceolate, acute, to 8 mm. long, 4 mm. broad, the auricle to 3 mm. long, glabrous, ciliate, 5-nerved; calyx to 3·5 mm. long, partly strigose, 10-nerved; standard to 8 mm. long. Loment with 4—5 articles; articles 2·2 mm. long, 2·0 mm. broad, the reticulation obscured, glabrous, with numerous hairy bristles 0·2—0·5 mm. long, sparsely glandular.

Type: *Drege s. n.*, from the Cape of Good Hope.

Cape of Good Hope.

3. **Zornia setosa** Baker f. Leg. Trop. Afr. 324. 1929; Milne-Redhead (1954) 99; Robyns (1954) 353; Cufodontis (1955) 298; Mohlenbrock (1961a) 41.

Perennial. Stems spreading, to 20 cm. long, branched, densely villous. Leaves with 4 leaflets; petiole much shorter than the leaflets, villous; leaflets obovate, obtuse, apiculate, densely punctate, villous along the midvein below, ciliate, 1-nerved, to 10 mm. long, 4 mm. broad; petiolule villous; stipules punctate, glabrous, ciliate, 5-nerved. Inflorescence congested; bracts elliptic, subfalcate, acute, to 6 mm. long, 2·5 mm. broad, the auricle to 0·5 mm. long, punctate, pilose, 5-nerved; calyx to 3·5 mm. long, sparsely punctate, pilose, 7-nerved; standard to 8 mm. long. Loment with 5—6 articles; articles compressed, 2·2—2·8 mm. long, 2·0—2·5 mm. broad, without reticulation, pilose, with numerous antrorsely hairy bristles 2·5—3·5 mm. long, glandular.

Type: *Purves 83*, from Nyasaland, Savannas.

Northern Rhodesia, Nyasaland, Portuguese East Africa.

4. **Zornia obovata** (Baker f.) Mohlenbrock, in Webbia *17* (*1*) : *41.* 1961.

Zornia tetraphylla Michx. var. *obovata* Baker f. Leg. Trop. Afr. 324. 1929.

Zornia setosa Baker f. ssp. *obovata* (Baker f.) Leonard & Milne-Redhead, in Bol. Soc. Brot. 28: 100. 1954; Robyns (1954) 353; Cufodontis (1955) 295.

Zornia tetraphylla sensu Harms (1911) 260; Fries (1914) 89; DeWildeman (1925) 387; Lebrun (1947) 309; Robyns (1948) 325; Lebrun, Taton & Toussaint

(1948) 80; Evans (1948) 270; Suessenguht & Merxmuller (1951) 26.—Non Michx. (1803).

Perennial. Stems prostrate, to 50 cm. long, branched, pilose. Leaves with 4 leaflets; petiole one-fourth to one-half as long as the leaflets, pilose; leaflets suborbicular to obovate, sometimes becoming oblanceolate above, obtuse, to 15 mm. long, 10 mm. broad, punctate, glabrous, except along the midvein below, 1-nerved; petiolule pilose; stipules punctate, glabrous, ciliate, 5- to 7-nerved. Inflorescence interrupted; bracts obovate, obtuse, to 10 mm. long, 8 mm. broad, usually smaller, the rounded auricle to 2·5 mm. long, punctate, glabrous, sparsely ciliate, 5-nerved; calyx to 3·5 mm. long, glandular, partly strigose, ciliate, 10-nerved; standard to 8 mm. long. Loment with 5—6 articles; articles 2·0—2·2 mm. long, 2·0—2·2 mm. wide, the reticulation usually obscured, pilose or glabrous, with numerous puberulent glabrous bristles 0·3—0·5 mm. long, glandular.

Type: *Whyte s. n.*

Belgian Congo, Ethiopia, Kenya, Northern Rhodesia, Ruanda-Urundi, Tanganyika, Uganda.

5. **Zornia tropica** (Milne-Redhead) Mohlenbrock, in Webbia 17 (1) : 45. 1961.
Zornia capensis var. *tropica* Milne-Redhead, in Bol. Soc. Brot. 28 : 101. 1954.

Perennial. Stems prostrate to ascending, to 7 cm. long, branched, glabrous or sparsely pubescent. Leaves with 4 leaflets; petiole longer than the leaflets, glabrous; leaflets narrowly lanceolate to narrowly elliptic, acute or apiculate, to 22 mm. long, 3 mm. broad, punctate along the margin, glabrous, 1-nerved; petiolule pilose; stipules lance-attenuate, epunctate, glabrous, 5-nerved. Inflorescence interrupted; bracts elliptic, acute, to 8 mm. long, 3·5 mm. wide, with the auricle to 2 mm. long, sparsely punctate, glabrous, ciliate; calyx to 3·5 mm. long, partly strigose, 7-nerved; standard to 7 mm. long. Loment with 5 articles; articles 2·2—2·5 mm. long, 1·8—2·2 mm. broad, without reticulation, glabrous, with numerous minutely hairy bristles 1·0 mm. long, sparsely glandular.

Type: *Drummond & Hemsley 3700*, from Tanganyika.

Kenya and Tanganyika.

6. **Zornia capensis** Pers, Syn. 2 : 318. 1807; Meyer (1835) 122; Ecklon & Zeyher (1836) 251; Mohlenbrock (1961a) *45*.

Hedysarum tetraphyllum Thunb. in Nov. Acta Reg. Soc. Sci. Upsal. 6 : 44. 1799; Thunberg (1823) 595.

Zornia tetraphylla sensu Oliver (1871) 159; Engler (1894) 86; Engler (1895) 216; Marloth (1925) 68; Galpin (1926) 89; Baker f. (1929) 323, in part; West (1951) 137.—Non Michx. (1803).

Zornia tetraphylla var. capensis Harv. in Harv. & Sonder, Fl. Cap. 2 : 225. 1861.

Zornia bracteata sensu Wood (1908) 148; Bews (1921) 112; Fourcade (1940) 54. —Non [Walt.] Gmel. (1791).

Perennial. Stems procumbent, branched, punctate, glabrous. Leaves with 4 leaflets; petiole one-half as long as the leaflets, punctate, glabrous; leaflets lanceolate or broadly lanceolate, acute, to 25 mm. long, 6 mm. broad, punctate, usually glabrous, 1-nerved; petiolule glabrous to puberulent; stipules punctate, glabrous, 7-nerved. Inflorescence rather interrupted; bracts ovate, acute, to 8 mm. long, 5 mm. broad, with the auricle to 3 mm. long, punctate, glabrous, 5-nerved; calyx to 4·5 mm. long, sometimes sparsely punctate, glabrous to partly strigose, 7-nerved; standard to 10 mm. long. Loment with 4—5 articles; articles 2·0—2·4 mm. long, 2·0—2·4 mm. broad, reticulate, glabrous, bristleless, with large glands.

Type: *Wylie 28023*, from Cape of Good Hope.

Grasslands.

Cape of Good Hope, Mozambique, Natal, Orange Free State, Southern Rhodesia, Swaziland, Transvaal.

7. **Zornia reptans** Harms in Engl. Bot. Jahrb. 28 : 406. 1900; Milne-Redhead (1954) 99; Mohlenbrock (1961a) 60.

Perennial. Stems prostrate, glabrous to puberulent. Leaves with 2 (rarely 3—4) leaflets; petiole puberulent to nearly glabrous; lower and upper leaflets ovate, glabrous or nearly so, to 15 mm. long, 12 mm. broad, punctate, 3- to 5-nerved; petiolule puberulent. Inflorescence congested near tip, becoming interrupted below; bracts lance-ovate, to 8 mm. long, 6 mm. broad, glabrous or nearly so, punctate, 3- to 7-nerved; calyx 7-nerved, partly strigose; standard 8—12 mm. long. Loment with 4—5 exserted articles; articles 1·8—2·0 mm. long, 1·8—2·0 mm. broad, glabrous, reticulate, bristleless, with golden glands.

Type: *Goetze 714*, from Tanganyika.

Tanganyika (Iringa and Njombe Districts).

8. **Zornia albolutescens** Mohlenbrock, in Kew. Bull. 15 : 327. 1961; Mohlenbrock (1961a) 65.

Perennial. Stems erect, to 20 cm. tall, branched, villous. Leaves with 2 leaflets; petiole half as long as the leaflets, villous; leaflets lance-oblong, acute, to 25 mm. long, 7 mm. broad, sparsely punctate, villous, 1-nerved, petiolule villous; stipules punctate, sparsely villous, 5-nerved. Inflorescence crowded near the tip, interrupted below; bracts lance-ovate, acute, to 9 mm. long, 5 mm. broad, the auricle to 1 mm. long, punctate, sparsely villous, densely ciliate, 6-nerved; calyx to 3 mm. long, partly strigose, 5-nerved; standard to 10 mm. long. Loment with 5 articles; articles 1·7 mm. long, 1·8 mm. broad, with reticulation the same colour as the body, glabrous, bristleless or with very few glabrous bristles 0·1 mm. long, glandular.

Type: *Bogdan 4023*, from Kenya.

Kenya.

9. **Zornia setifera** Mohlenbrock, in Webbia 17 (1) : 69. 1961.

Zornia pratensis Milne-Redh. ssp. *barbata* J. Leon & Milne Redh. in Bol. Soc. Brot. 28 : 96. 1954; Robyns (1954) 359.

Perennial. Stems stiffly erect, to 20 cm. tall, branched, glabrous. Leaves with 2 leaflets; petiole one-third to two-thirds the length of the leaflets, glabrous; leaflets linear-lanceolate, acute, mucronate, usually sparsely punctate, glabrous, 1-nerved, to 30 mm. long, 5 mm. broad; petiolule ciliate; stipules very sparsely punctate or epunctate, glabrous, 5- to 7-nerved. Inflorescence congested near tip, interrupted below; bracts lanceolate to lance-ovate, acute, to 10 mm. long, 6 mm. broad, with an oblique auricle to 2·5 mm. long, sparsely punctate to epunctate, glabrous, ciliate, 5-nerved; calyx to 4·5 mm. long, partly strigose, 7- to 10-nerved; standard to 10 mm. long. Loment with 5—6 articles; articles 2·0—2·2 mm. long, 2·0 mm. broad, the reticulation obscured, glabrous, with numerous densely antrorsely hairy bristles 3—5 mm. long, eglandular.

Type: *Noirfalise 98*, from South Africa.

Open grasslands or frequently burned-over areas.

Northern Rhodesia and Tanganyika.

10. **Zornia durumuensis** DeWild. in Rev. Zool. Afr. 1 : 413. 1928; Baker f. (1929) 323; Andrews (1952) 248; Keay (1954) 576; Robyns (1954) 357; Milne-Redhead (1954) 99; Mohlenbrock (1961a) 70.

Zornia lelyi Hutch. & Dalz. Fl. W. Trop. Afr. 1 : 413. 1928.

Perennial. Stem erect, to 20 cm. tall, simple or branched from the base, hirsute to nearly glabrous. Leaves with 2 leaflets; petiole about one-half as long as the leaves, glabrous to puberulent; leaflets lanceolate or linear-lanceolate, acute, to 25 mm. long, 5 mm. broad, densely short-hairy, epunctate, usually 1-nerved; petiolule villous; stipules villous to nearly glabrous, 5-nerved. Inflorescence somewhat interrupted to very crowded; bracts elliptic to ovate, acute, pilose to hirtellous, epunctate, 3- to 5-nerved, the auricle 1·0—1·5 mm. long; calyx to 3·0 mm. long, partly strigose; standard 6—10 mm. long. Loment long exserted, with 5—7 articles; articles 2·8—3·2 mm. long, 2·0—2·4 mm. wide, the reticulum obscured, with numerous retrorsely hairy bristles 2—4 mm. long, eglandular.

Type: *Magis s. n.*, from tropical Africa.

Anglo-Egyptian Sudan, Belgian Congo, Chari, Nigeria.

11. **Zornia pratensis** Milne-Redh. in Bol. Soc. Brot. 28 : 93. 1954; Robyns (1954) 358; Cufodontis (1955) 297; Mohlenbrock (1961a) *74.*

Zornia diphylla sensu Hiern (1896) 239, in part; Mildbraed (1911) 260; DeWildeman (1921) 88, in part; DeWildeman (1925) 387, in part; Lebrun (1947) 309, in part; Robyns (1948) 325, in part; Lebrun, Taton & Toussaint (1948) 80.—Non (L.) Pers. (1807).

Perennial. Stems prostrate to erect, to 35 cm. tall, branched, glabrous. Leaves with 2 leaflets; petiole as long as the leaflets, glabrous; leaflets linear-elliptic to lanceolate, acute or subacute, punctate, glabrous, 1-nerved, to 27 mm. long, 5 mm. broad; petiolule ciliate; stipules punctate, glabrous, ciliate, 3- to 5-nerved. Inflorescence interrupted; bracts broadly lanceolate, acute, to 8·0 mm. long, 4·0 mm. wide, with an acute auricle to 2·0 mm. long, punctate, glabrous, ciliate, obscurely 3- to 5-nerved; calyx tube to 3·5 mm. long, partly strigose; standard to 8·0 mm. long. Loment usually with 7 articles; articles usually 2·0 mm. long, 1·8 mm. broad, the venation apparent, minutely pubescent or rarely glabrous, with retrorsely hairy bristles to 1·0 mm. long, eglandular.

Type: *Drummond & Hemsley 4517*, from Kenya.

Anglo-Egyptian Sudan, Angola, Belgian Congo, Ethiopia, Kenya, Northern Rhodesia, Nyasaland, Ruanda-Urundi, Southern Rhodesia, Tanganyika, Uganda.

12. **Zornia brevipes** Milne-Redh. in Bol. Soc. Brot. 28 : 98. 1954; Mohlenbrock (1961a) 81.

Stems ascending, to 35 cm. tall, branched, glabrous. Leaves with 2 leaflets; petiole much shorter than the leaflets, glabrous; leaflets narrowly oblanceolate to linear-elliptic, acute to apiculate, to 52 mm. long, 9 mm. broad, densely punctate, glabrous; petiolule glabrous; stipules punctate, glabrous, 5-nerved. Inflorescence crowded; bracts ovate, acute, to 16 mm. long, 5 mm. broad, punctate, glabrous, ciliate, 5-nerved; calyx to 4 mm. long, ciliate, 7-nerved; standard to 6 mm. long. Loment with 6 articles; articles 2·0—2·2 mm. long, 2·0 mm. broad, reticulate, glabrous, nearly without bristles, glandular.

Type: *Davies 183*, from Tanganyika.

Tanganyika (Mbeya and Iringa Districts).

13. **Zornia puberula** Mohlenbrock, in Kew Bull. 15 : 330. 1961; Mohlenbrock (1961) 87.

Zornia diphylla sensu Drake (1902) 165; Palacky (1907) 80.—Non (L.) Pers. (1807).

Perennial. Stem to 25 cm., branched, glabrous to sparsely pilose in the inflorescence. Leaves with 2 leaflets; petiole one-third to one-half as long as leaflets, glabrous; leaflets ovate, subacute, epunctate, glabrous, 1-nerved, to 15 mm. long and 8 mm. broad; petiolule glabrous; stipules acuminate at both ends, the blade to 6 mm. long, the auricle to 4 mm. long, epunctate, glabrous, 5- to 6-nerved. Inflorescence congested; bracts ovate-lanceolate, acute, to 9 mm. long and 4 mm. broad, the auricle to 4 mm. long, punctate, glabrous, ciliate, 5- to 7-nerved; calyx tube to 4 mm. long, partly strigose, 7-nerved; standard to 12 mm. long. Loment with 3—5 included articles; articles 1·7 mm. long, 1·6 mm. wide, obscurely reticulate, densely puberulent throughout, bristleless, eglandular.

Type: *Baron 671*, from Madagascar.

Madagascar.

14. **Zornia glochidiata** Reichb. ex DC., Prodr. 2 : 316. 1825; A. Richard (1847) 201; Andrews (1952) 248; Keay (1954) 575; Milne-Redhead (1954) 87; Robyns (1954) 356; Cufodontis (1955) 297; Mohlenbrock (1961a) *108*.

Zornia biarticulata G. Don, Gen. Syst. 2 : 280. 1832.

Zornia angustifolia Sm. in Rees, Encycl. 34 : 1. 1819, in part, nomen illeg.; Guillemin, Perottet, & A. Richard (1830) 203; Hooker (1848) 121; Peters (1862) 121.

Zornia diphylla sensu Oliver (1871) 158, in part; Grant (1875) 59; Engler (1895) 216; Hiern (1896) 239, in part; DeWildeman (1921) 207, in part; DeWildeman (1921) 88, in part; DeWildeman (1925) 387, in part; Hutchinson & Dalziel (1927) 413, in part; Baker f. (1929) 322; Broun & Massey (1929) 195, in part; Irvine (1930) 446; Chiovenda (1932) 165, in part; Trochain (1940) 386; Lebrun (1947) 309, in part; Robyns (1948) 325, in part.—Non (L.) Pers. (1807).

Zornia diphylla var. *glochidiata* Hooker, Nig. Fl. 301. 1848.

Zornia diphylla var. *vulgaris africana* Benth. in Mart. Fl. Bras. 15 (2) : 82. 1859.

Annual from slender roots. Stems erect, to 50 cm. tall, slender, branched, glabrous or strigose. Leaves with 2 leaflets; petiole averaging two-thirds the length of the leaflets, glabrous or strigose; leaflets lanceolate, acute, usually epunctate, nearly glabrous on both surfaces, 1-nerved, to 40 mm. long and 10 mm. broad; petiolule ciliate; stipules epunctate, usually glabrous, 3- to 5-nerved. Inflorescence congested; bracts ovate, acute, to 10 mm. long and 6 mm. broad, with an acute auricle to 2 mm. long, usually epunctate, glabrous, ciliate, 5-nerved, with obscure lateral nerves; calyx tube 3·5 mm. long, partly strigose; standard to 14 mm. long. Loment usually with 4 articles; articles to 3·2 mm. long, to 2·7 mm. wide, the reticulation rather obscured by the bristles, glabrous, with numerous retrorsely hairy bristles 1·0—2·5 mm. long, glandular or eglandular.

Type: *Sieber 40*, from Senegal.

Anglo-Egyptian Sudan, Angola, Belgian Congo, Cape Verde Islands, Eritrea, Ethiopia, French Guinea, French Sudan, Gambia, Gold Coast, Kenya, Mozambique, Nigeria, Northern Rhodesia, Portuguese East Africa, Portuguese Guinea, Senegal, Sierra Leone, Somalia, Southern Rhodesia, South West Africa, Tanganyika, Togo, Transvaal, Uganda.

15. **Zornia apiculata** Milne-Redh. in Bol. Soc. Brot. 28 : 90. 1954; Cufodontis (1955) 297; Mohlenbrock (1961a) 119.

Perennial. Stems prostrate to erect, to 50 cm. long, branched, puberulent or glabrous. Leaves with 2 leaflets; petiole three-fourths as long as to equalling the leaflets, puberulent to glabrous; lower leaflets broadly ovate, to 25 mm. long and 16 mm. broad with a few obscure nerves, nearly glabrous, ciliate, the upper leaflets ovate-lanceolate, to 20 mm. long and 8 mm. broad, 1-nerved, nearly glabrous, ciliate; petiolule ciliate; stipules punctate, usually glabrous, 5-nerved. Inflorescence partly interrupted; bracts ovate, acute, to 11 mm. long and 8 mm. broad, the acute auricle to 3 mm. long, punctate, glabrous, ciliate, 5-nerved, with a few lateral nerves; calyx tube to 3·5 mm. long, partly strigose; standard to 6 mm. long. Loment with 6 articles; articles averaging 2·0 mm. long and 2·0 mm. broad, reticulate, minutely hairy, with retrorsely hairy bristles 0·5—1·0 mm. long, eglandular.

Type: *Gillett 13566*, from Kenya.

Dry areas.

Ethiopia, Kenya, Somalia, Somaliland Protectorate, Tanganyika.

16. **Zornia latifolia** Sm. in Rees, Cycl. 39 : 4. 1819; Keay (1954) 576; Milne-Redhead (1954) 89; Mohlenbrock (1961a) 126.

Zornia gracilis DC. Prodr. 2 : 316. 1825.

Zornia diphylla var. *gracilis* (DC.) Benth. in Mart. Fl. Bras. 15 (1) : 81. 1859. Baker f. (1929) 323.

Perennial. Stems erect, to 80 cm. tall, branched, glabrous. Leaves with 2 leaflets; petiole nearly equalling to longer than the leaflets, glabrous, lower leaflets ovate to lance-ovate, apiculate, to 30 mm. long, 15 mm. broad, the upper leaflets lanceolate to linear-lanceolate, acute, to 36 mm. long, 8 mm. broad, usually much narrower, punctate, glabrous above, glabrous or strigose below, several-nerved; petiolule villous; stipules epunctate or sparsely punctate, glabrous, 5-nerved. Inflorescence congested near tip, usually becoming interrupted below; bracts linear, acuminate, to 10 mm. long, 2 mm. broad, with the auricle to 2 mm. long, glabrous to sparsely villous, ciliate, 4-nerved; calyx to 3·5 mm. long, partly strigose, 5- to 7-nerved; standard to 9 mm. long. Loment with 4—6 articles; articles 2·0—2·2 mm. long, 1·8—2·0 mm. broad, the reticulation obscured, villous, with retrorsely hairy bristles 0·8—1·2 mm. long, eglandular.

Adventive along the west-central section of Africa.
Liberia, Togo.

3. ARACHIS L. Sp. PL. 2 : 741. 1753.
Only the following species in Africa.

1. **Arachis hypogaea** L. Sp. Pl. 2 : 741. 1753; Hooker (1848) 122, 301; Harvey & Sonder (1861) 226; Peters (1862) 42; Oliver (1871) 158; Grant (1875) 59; Ascherson & Schweinfurth (1887) 755; Battandier & Trabut (1888) 284; Engler (1895) 216; Hiern (1896) 239; Durand & Schinz (1896) 108; Drake (1902) 165; Pobeguin (1906) 103; Palacky (1907) 80; Wood (1908) 148; Muschler (1912) 537; Bews (1921) 111; deWildeman (1925) 386; Marloth (1925) 68; Hutchinson & Dalziel (1927) 413; Broun & Massey (1929) 195; Ramis (1929) 119; Baker (1929) 322; Irvine (1930) 37; Trochain (1940) 365; Exell (1944) 155; Andrews (1952) 175; Keay (1954) 576; Robyns (1954) 351; Cufodontis (1955) 297.

Annual, from a taproot. Stem branching from the base, glabrous or villosulous. Leaves 4-foliolate; stipules to 3 cm. long, lance-acuminate, subfalcate, the lower third united to the petiole; leaflets ovate to elliptic, to 60 mm. long, 30 mm. wide, rounded at base, subacute to obtuse or emarginate at apex, glabrous or with a few long hairs below; petiolules articulated, to 5 mm. long, hirsute; inflorescence axillary, the flowers subsessile in fascicles of 2—6, yellow to orange; receptacular tube slender, to 40 mm. long, pilose to glabrescent; calyx bilabiate, 10—12 mm. long; corolla 10—12 mm. long; fruit ovoid or oblong-cylindric, 2—6 cm. long, constricted between the seeds, reticulate; seeds 1—6, ovoid to oblongoid.

Known only in cultivation and as an occasional escape throughout Africa.

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NEW SPECIES AND NOTES ON TYPE SPECIMENS OF SOUTH AFRICAN ENCEPHALARTOS

R. A. Dyer
(*Botanical Research Institute*)
(With Plates XIX & XX)

Encephalartos princeps R. A. Dyer sp. nov., *E. lehmannii* Lehm. affinis, sed truncis longioribus, petioli pulvino minore, strobilis 2—4, megasporophylli bulla irregulariter et crasse papillosa differt.

Encephalartos lehmannii Auct. in part, not of Lehm., Hutch. & Rattr. in F.C. 5 (Suppl.) 36 (1933) as to specimens from Queenstown etc.; Henderson form "D" in Journ. S.A. Bot. 11, 1 : 30 (1945).

Planta saepe e base ramosa; trunci usque ad 3 m. vel rariter 4 m. alti, 20—30 cm. diametro. *Folia* 75—110 cm. longa, apicem versus recurva et nonnunquam leviter torta, glauca; petiolus 15—21 cm. longus pulvino lanato; foliola lineari-lanceolata, pungentia, usque 15 cm. longa, integra. *Strobili* 2—4, breviter pedunculati: *masculinus* elliptico-oblongus, 16—26 cm. longus, 8—10 cm. diametro; microsporophylla mediana plusminusve 3 cm. longa, 1·5—1·8 cm. lata; bulla 1·2—1·5 cm. prominens, vulticulo terminali 5—8 mm. × 4—6 mm.: *femineus* plusminusve cylindricus, apice rotundato, usque 30 cm. longus, 20 cm. latus; megasporophylla mediana circiter 7 cm. longa; bulla 4—4·5 cm. lata, 3—3·5 cm. crassa, circiter 2 cm. prominens, irregulariter papillosa, sparse tomentosa, vulticulo terminali concavo plusminusve 1·5 cm. lato, 1 cm. crasso. *Semina* circiter 4 cm. longa, 2 cm. diametro.

DISTRIBUTION

QUEENSTOWN DIV.: Among doleritic rocks on lower hill-slopes of Swart Kei Valley, with *E. friderici-quilielmi* Lehm., 2,300—2,600 ft., *Galpin* 8090 (PRE holotype). Cathcart Div.; *Henderson* 1594. King William's Town Div.; Peninsula Farm on Kabousie River, *Comins* 1661. Komga Div.; Junction or Mooifontein Farm on Kabousie River, *Verdoorn & Christian* 708; *Dyer* 4525; *Dyer & Wells* 5792; *Flanagan* 1373 (SAM). Tsomo Div.; near Tsomo, *Sim* (SAM). Butterworth; Kei River Valley below railway bridge, *Verdoorn & Christian* 709; *Dyer* 4508; *Smith & Latimer* 261; *Dyer & Wells* 5793; 5794.

In earlier literature specimens of this species have been confused with *Encephalartos lehmannii* Lehm. They differ in several characters. Firstly, *E. princeps* is taller and the trunks relatively slender; secondly, 2—4 cones are produced on a stem as opposed to the normal one of *E. lehmannii*; further, the face of the female cone-scale is coarsely papillose or warty as opposed to the ridged yet relatively smooth surface of *E. lehmannii*; and in addition the leaves of *E. princeps* are usually denser, shorter and have a smaller pulvinus which is often hidden by the scale-bracts, whereas in *E. lehmannii* the pulvinus is large and exposed with a red-brown collar.

E. princeps is concentrated in the eastern Cape Province within the middle and lower reaches of the Kei River catchment including the Swart Kei and Kabousie Rivers, mainly on doleritic outcrops and cliffs. It is claimed to occur in a valley further east but the record requires confirmation. Galpin records that it occurs with *E. friderici-guilielmi* Lehm. near the Swart Kei about five miles from the junction with the White Kei River.

The specific epithet was chosen because it reflects the thought that *E. princeps* has had a longer history and has a more stately habit than its near allies *E. lehmannii* and *E. trispinosus* (Hook.) R. A. Dyer.

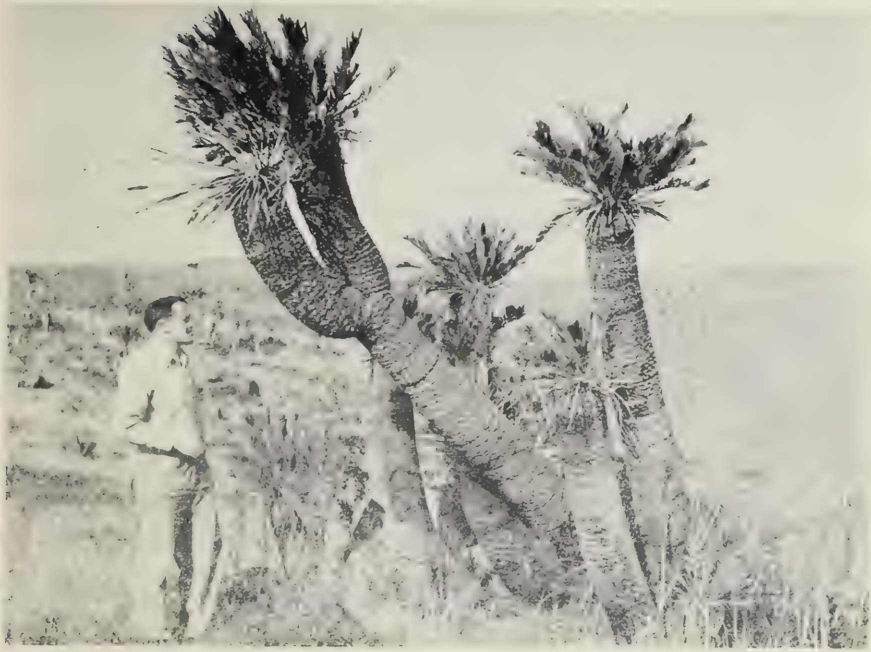
Encephalartos trispinosus (Hook.) R. A. Dyer stat. nov.

E. horridus var. *trispinosa* Hook. in Curtis's Bot. Mag. t. 5371 (1863); Type: tab. 5371, l.c., specimen preserved in 1880 in K.

E. horridus Schuster in part, not of Lehm., in Pflanzenr. 4, 1 : 116 (1932).

E. lehmannii Auct. in part, not of Lehm., Hutch. & Rattr. in Fl. Cap. 5, 2 (Suppl.) 34 (1933); Henderson in Journ. S.A. Bot. 11, 1 : 32 Form B1 (1945).

Plant unbranched or branched from the base with stems up to about 1 m. tall and 25—30 cm. diam. *Leaves* glaucous-green when young, becoming green with age, 0·75—1·25 m. long including petiole 15—22 cm. long, glabrous; rhachis stiff, usually recurved and often twisted towards apex, with dirty white collar round tomentose pulvinus; leaflets spaced and reduced in size and mainly entire towards the base, occasionally overlapping in upper half; median leaflets linear-lanceolate, or oblong-lanceolate, often somewhat falcate, 10—18 cm. long, 1·5—2·5 cm. broad, pungent with terminal spine up to 6 mm. long, some or all with 1—2 pungent sometimes twisted lobes 1—3 cm. long from lower margin. *Cones* solitary, general colour blue-green or yellowish-green, shortly and stoutly pedunculate: *male* subcylindric, narrowed to both ends, 25—35 cm. long, 6·5—7·5 cm. diam.; median scales about 2·5 cm. long, 2·5—2·8 cm. broad with sharp lateral angles; bulla face projected into a beak 7 mm. long; terminal facet about 6 mm. broad and 6 mm. wide vertically: *female* broadly cylindric, barrel or egg-shaped, rounded at apex, 45—50 cm. long and 16—18 cm. diam.; median scales 8—9 cm. long, 6—7 cm. broad and 4 cm. thick vertically, with lateral ridges extending into the incurved lateral lobes 2—2·5 cm. long; bulla protruding 2·5—3 cm., sparsely hairy with ad-



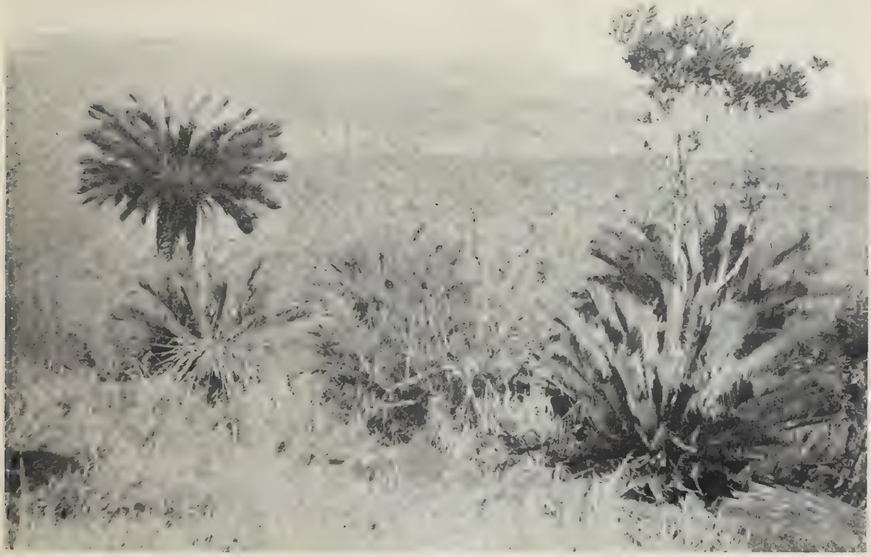
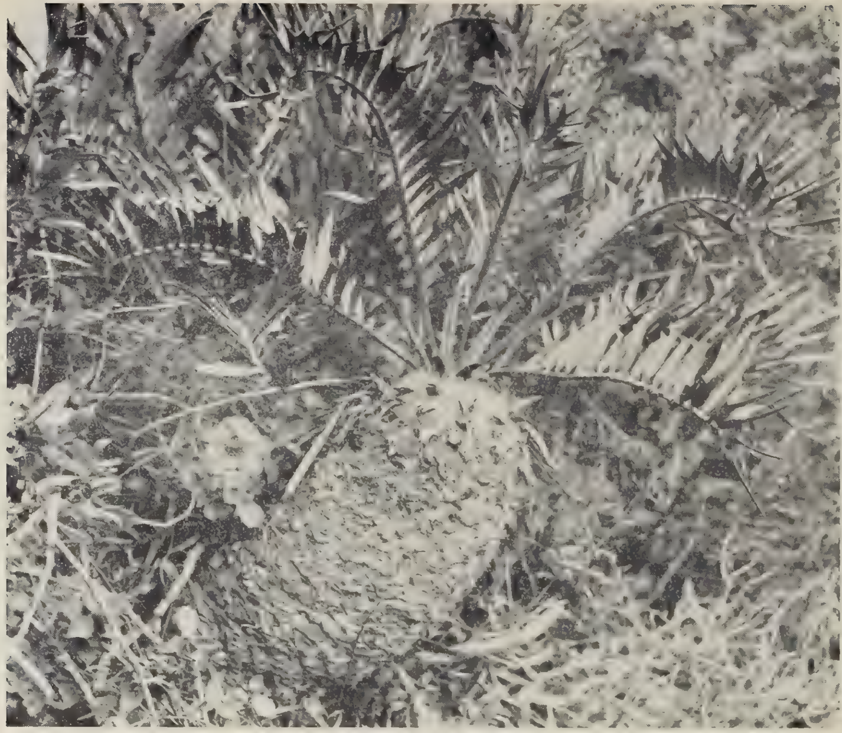


PLATE XIX

1 and 2. *Encephalartos princeps* R. A. Dyer, overlooking Kabousie River in Komga district (= *Dyer and Wells* 5792).



1. *Encephalartos trispinosus* (Hook.) R. A. Dyer, Plutos Vale in Albany district (= *Dyer & Wells* 5801).

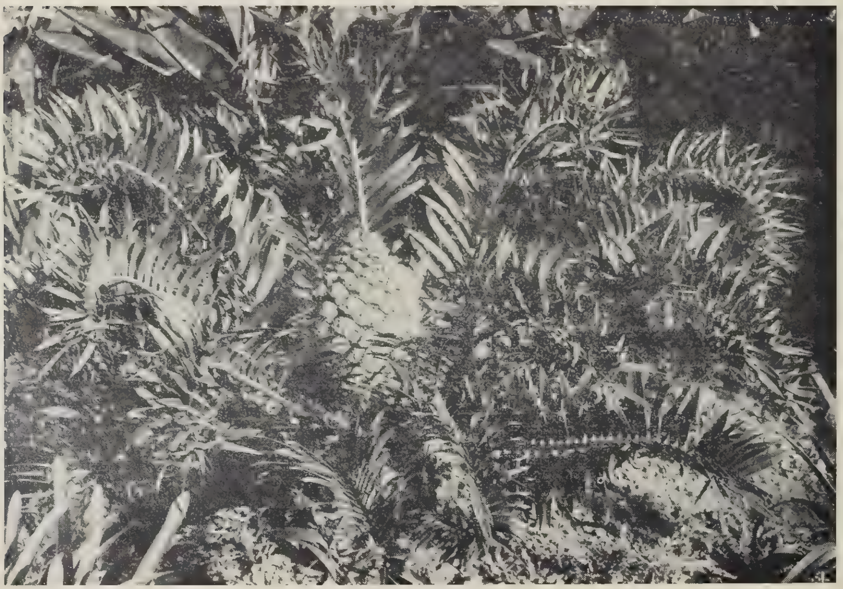


PLATE XX

2. *Encephalartos trispinosus* (Hook.) R. A. Dyer, cultivated at East London Museum, from 4 miles west of Hunts Drift in Bathurst district; collected by G. G. Smith.

pressed whitish hairs; upper facet with rugose ridge and with irregular pointed papillae or sometimes nearly smooth; lower facet rounded; terminal facet smooth or sparsely pitted, concave, about 1 cm. broad and 1 cm. wide vertically. *Seeds* reddish to yellowish-orange, about 5 cm. long and 2 cm. diam., with fleshy beak (there is likely to be greater variability in cone size than recorded here based on limited material).

In the eastern Cape in karroid scrub and bush of the lower reaches of the Bushmens and Fish River Valleys.

DISTRIBUTION

ALEXANDRIA. *Verdoorn & Christian* 697; *Compton* 19697B.

BATHURST. *Dyer & Wells* 5796; 5797; *Acocks* 16152.

ALBANY. *Galpin* 3083; *Verdoorn & Christian* 703; 703a, 704; *Dyer* 1184; 4842. *Dyer & Wells* 5801, *Acocks* 12769.

VICTORIA EAST. *Acocks* 15979.

PEDDIE. *Dyer* 4547B; *Smith* 5815; *Verdoorn & Christian* 705; 706.

Hooker wrote in Curtis's Botanical Magazine, 1863: "After the most careful examination of our plant, I can only come to the conclusion that it is one of the many varieties of *E. horridus*; with a great tendency to have, on the inferior margin of the pinnules, two large spinescent laciniae, which, in conjunction with the terminal spines, justify the application of the term var. *trispinosa*".

Schuster (l.c.) regarded the Bot. Mag. figure as representing a form of *E. horridus* (Jacq.) Lehm., while Hutchinson & Rattray and Henderson dealt with it under *E. lehmannii* Lehm. After considerable meditation, backed up by field observations, it is deemed desirable to recognise *E. horridus* var. *trispinosa* as a distinct species from both *E. horridus* and *E. lehmannii*, under the name *E. trispinosus*. The affinity seems considerably stronger with *E. horridus* and the distinction is not always obvious between variants of the two. Henderson's concept of *E. lehmannii* is now classified into three groups of specific status: *E. lehmannii*, *E. trispinosus* and *E. princeps*, and there is a residue of indeterminate origin including some supposed hybrids.

The figure in Bot. Mag. t. 5371 can be matched very closely by specimens in the lower reaches of the Bushmans and Fish River Valleys. These are sufficiently distinct, numerous, widely spread and tolerably uniform in habit, and often isolated from any other species, to justify specific status. While there is no means of confirming that the type specimen was collected within this environmental range, conversely, it would not be possible to deny the possibility. When Galpin collected his No. 3083 (cited above) in 1898, he identified it as *Encephalartos horridus* var. *trispinosa* Hook. by comparison with the Bot.

Mag. figure and his specimen in the National Herbarium, Pretoria, including female cone material, is regarded as typical of the species. There appears to be no earlier epithet which could, with equal confidence, be applied and the only alternative would seem to be to give an entirely new one. Caution in adopting the specific epithet was necessary because of the close relationship with *E. horridus* and the presence within the distribution range of *E. trispinosus* of specimens which do not conform to a species pattern and give the impression that natural hybridization has taken place. Field observations appear to confirm the supposition.

The first botanist to generalize on the relationships of specimens in the eastern Cape Province was Charles Zeyher whose notes were read in 1852 before a scientific gathering and published in the Phytologist. After mentioning that any person with "tact" should have no difficulty in detecting the "play of nature" he went on to say that he intended to examine all the populations once more in their natural state. The outcome of this undertaking is not recorded and Zeyher's warning seems to have gone unheeded.

Plants of supposed hybrid origin occur two miles up the Bushmans River and in the lower reaches of the Fish River Valley. These appear to combine the characters of *E. trispinosus* and *E. altensteinii* both of which are present in the areas. *E. arenarius* R. A. Dyer, the typical form of which is a few miles west of Bushmens River in a secluded valley may also be involved and *E. latifrons* cannot be ignored. (There is a strong suspicion that *E. latifrons* has been involved in hybridization with *E. altensteinii* at least).

On the other hand neither typical *E. horridus* nor *E. lehmannii* occurs as far east as Bushmans River. *E. horridus* is apparently isolated in its distribution range in the districts of Uitenhage and Port Elizabeth while only *E. longifolius* occurs with *E. lehmannii* in a limited area of its distribution range along the Klein Winterberg.

If one indulges in speculation one might suggest that both *E. horridus* and *E. lehmannii* evolved in the far distant past from *E. tridentatus* stock. The stem has been reduced and the lobing of the leaflets accentuated in *E. horridus*, whereas in *E. lehmannii* the stems are more robust and the leaflets mainly entire. An occasional part-reversion within the normal populations of these two species in the direction of *E. tridentatus* indicates this possibility—a stem up to 4 ft. in *E. horridus* (*Story* 2338) and specimens of *E. lehmannii* with teeth on the lower margin of some leaflets (*Verdoorn & Christian* 689, 689a, 689b). It is believed that these variations have been viewed on a rational basis in the present treatment in not giving them distinctive rank. Were cones available from all specimens, it is felt that they would be relatively uniform and sufficiently distinctive within the groups afforded specific status.

Encephalartos cycadifolius (Jacq.) Lehm. — *Zamia cycadifolia* Jacq.

When describing *Zamia cycadifolia*, Jacquin, Fragm. 27, t. 25 *&* 26 (1801) stated that the plant collector Georgius Scholl had returned from the Cape with three new species of *Zamia*, which were then flourishing in the royal garden of Schoenbrunn in Vienna. Scholl brought also one male and two female cones, which were presumed to have belonged, one each to the same species as the living plants. Jacquin described and figured the species, filling in the missing parts of the cones. Unfortunately any specimen which Jacquin may have preserved at the time has since perished and one must rely for the most part on his description and figures to interpret his concept of the species. There is, however, a leaf specimen of *Z. cycadifolia* from the Schoenbrunn garden in the Willdenow herbarium under the number 18529, now the property of the Berlin-Dahlem Herbarium.

In 1834 Lehmann, in Pugil. 6 : 13, transferred the name *Z. cycadifolia* to *Encephalartos* and at the same time described the species *Encephalartos friderici-guilielmi*, which he distinguished from *E. cycadifolius*, mainly on the following grounds: the trunk was woolly (as opposed to glabrous) the rhachis was woolly (as opposed to pubescent) and the fruit densely woolly (as opposed to the presumed glabrous cone of *E. cycadifolius*). The identity of *E. friderici-guilielmi* in the wild state in the districts of Queenstown and Cathcart is unquestioned because it fits Lehmann's description so well, based on specimens collected in that area by Ecklon & Zeyher.

With little preserved material to judge by, there has been continuous speculation whether Lehmann was justified in distinguishing his species from that of Jacquin. To cite a few authorities, Miquel in his Monograph. Cycad. 1842, accepted the two as distinct, although he queried whether *E. cycadifolius* could be a juvenile form of *E. friderici-guilielmi*. A. De Candolle, in Prod. 16, 2 : 530 (1868), combined the two species, whereas Thiselton-Dyer, discussing the relationship of *E. cycadifolius*, *E. friderici-guilielmi* and *E. ghellinckii* Lehm. a decade later in the Gardener's Chronicle 1878 p. 810, remarked on the glabrous cones ascribed to *E. cycadifolius* and concluded by giving the opinion that the three were closely allied but distinct.

Subsequently Hutch. & Rattr. in Fl. Cap. 6, 2 : 42 (1933) claimed that Jacquin's concept of *Zamia cycadifolia* was based on a mixture of two species, the stem and leaf of one and the cone of another. The cone was considered to belong to a species such as *E. villosus*. The plant was considered by them to be specifically equal to Lehmann's *E. friderici-guilielmi*, which name they consequently relegated to synonymy. Jacquin, it must not be overlooked, compared his species with *Cycas revoluta* for habit and it is clear that the leaf figured by Jacquin (and confirmed by the specimen in the Willdenow Herbarium) has leaflets with slightly recurved margins, narrower and significantly more widely spaced than those of mature leaves of *E. friderici-guilielmi*, to such an extent that it is highly improbably that it represents even a juvenile form of the latter. The stem figured by Jacquin appears young, but certainly beyond the seedling stage, as it was said to be 1 ft. long and budding from the base. There is another important point and that is that European penetration, let alone botanical collectors, had not reached the Bantu-occupied neighbourhood of Cathcart or Queenstown (the western-most occurrence and type locality from which *E. friderici-guilielmi* is recorded) in the time of Scholl, who returned to Europe in 1799.

It is now clear that the leaf figured by Jacquin resembles closely those of *Encephalartos eximius* Verdoorn, described in Bothalia 6, 2 : 246 (1954). *E. eximius* is known from the districts of Bedford and Cradock, which area was more accessible to European exploration before 1799 than was Cathcart. On the other hand there is no published record of a botanical expedition through the area at such an early date. The mountains east of Bedford and Cradock are still comparatively isolated in a farming area and the Cycad there appears to have been collected only two or three times in the 150 years since 1800, whereas the more robust species from Queenstown-Cathcart has for many years been evident from the railway line and national road passing through the district. It is fairly common in cultivation.

Is one justified in taking the viewpoint that Jacquin's description and figure 26 covered *E. eximius* and not *E. friderici-guilielmi* or should Jacquin's epithet *cycadifolius* be rejected as a *nomen confusum*.

To answer this query it was essential to consult, if possible, the leaf specimen in Willdenow's herbarium, No. 18529. An excellent photograph and a pinnule were obtained by the courtesy of the Director of the Berlin-Dahlem Herbarium. There seems no doubt that the leaf was from Jacquin's type plant. The comparison with *E. eximius* is very close but there is not absolute identity. The pinnule is 9 cm. long, 3 mm. broad, has 3—4 veins on the lower surface in addition to those along the margin and is glabrous on both surfaces. Jacquin describes the leaves as with greyish hairs which fall away by rubbing. Median pinnae of *E. eximius* are 9—13 cm. long, 4—5 mm. broad with thickened, slightly recurved margins and, on the lower surface, has 5—6 prominent nerves in addition to those along the margin and is sparsely pilose or scurfy. The pinnae of seedlings, however, are glabrous.

To refer again briefly to the cone Jacquin illustrated, he described it as "fuscum" (dusky, too brown for grey) and the seeds "coccineam" (red, cochineal or carmine). He omitted to state whether it was glabrous or tomentose. Lehmann and subsequent workers have taken it as glabrous. Present knowledge makes it clear that no species from the eastern Cape has fuscous glabrous cones with red seeds. The only cones which could be described as fuscous are the old woolly cones of *E. friderici-guilielmi* and *E. eximius*, but both have orange-yellow to amber-brown seeds, not red. It is conceivable that the cone was originally woolly and that an error was made in the colour of the seeds recorded by Jacquin, because the seeds could not have been fresh when he first saw them. Nevertheless it does seem that the illustration of the cone must be excluded from an interpretation of *Zamia cycadifolia* Jacq.

In giving specific status to *E. eximius*, the author, Inez Verdoorn, was influenced by the view supported by Hutchinson and Rattray in Fl. Cap. 1933, that *E. cycadifolius* (Jacq.) Lehm. was conspecific with *E. friderici-guilielmi* Lehm. She was at pains to distinguish three closely related species (as was Thiselton-Dyer mentioned earlier), the first from the upper catchment area of the Great Fish River (Bedford-Cradock) the second further east in the upper catchment of the Great Kei River (Queenstown-Cathcart) and the third species even further east on the eastern Cape-Natal border (*E. ghellinckii* Lem.).

The reassessment of available data, as outlined above, seems overwhelmingly in favour of identifying *E. cycadifolius* (Jacq.) Lehm. with the species in the Bedford and Cradock districts (the photograph illustrating *E. eximius* shows a strong likeness to the portion of stem figured by Jacquin). The decision to follow this conclusion necessitates the re-application of the name *E. cycadifolius* to the Bedford-Cradock plants, the placing under it the synonym *E. eximius* and the restoration of the specific status of *E. friderici-guilielmi* for the Queenstown-Cathcart plants. However awkward it may be to pronounce the specific epithet *friderici-guilielmi* one may not overlook the fact that the name honours an early patron of botany.

Encephalartos villosus

In 1788 Gaertner, in de Fructibus et Seminibus Plantarum, described a cone under the name *Zamia-caffra* (*villosa*), founded on *Cycas caffra* Thunb. But on his accompanying plate, t. 3, Gaertner called it simply *Zamia villosa*. There is little doubt that the cone was specifically equal to Thunberg's *Cycas caffra*, as to t. 5 in Nov. Act. Soc. Scient. Upsal. 2 (1775), which now bears the name *Encephalartos caffer* (Thunb.) Lehm.

The name *Zamia villosa* in Herb. van Royen, referred to by A.DC. in DC. Prod. 16, 2 : 54 (1868) as a synonym of *E. caffer* (presumably of (Thunb.) Lehm.), has no nomenclatural standing and may be ignored.

In 1867 Lemaire described a species under the name *Encephalartos villosus* in Ill. Hort. 14, Misc. 79, which was the first use of the epithet in combination with *Encephalartos*, although he mentioned that the plant already bore this appropriate epithet *villosus* in commerce and cited *Zamia villosa* Hort. A. Verschaffelt as his authority for this. There is no allusion to *Zamia villosa* Gartn. It is also important that there is no reference to *Zamia villosa* under Bot. Mag.

t. 6654 (1882) which is undoubtedly what it is titled, namely *Encephalartos villosus* Lem. and it may well have been based on specimens from the same source. There is no apparent reason why Lemaire should not have selected the epithet *villosus* in the genus *Encephalartos* for a plant which he regarded as botanically undescribed.

There was, therefore, no justification for Schuster in Pflanzenreich 4, 1 : 118 (1932) and Hutch. & Rattr. in Fl. Cap. 5, 2 (Suppl.) 30 (1933) to regard the Lemaire epithet *villosus* as an adoption from Gaertner. Had this been so it is clear that *E. villosus* Lem. would require a new name. Fortunately this is not so because the species is widespread in nature and cultivated in many parts of the world.

In the absence of exact information one might assume that the type specimen of *E. villosus* was collected in the neighbourhood of East London, because it is abundant there and it is the nearest natural habitat to the Cape. Mr. R. Strey, Officer-in-Charge of the Natal Herbarium, Durban, brought to my notice a register kept by M. J. McKen during his period of office as curator of the Durban Botanic Garden. McKen arrived in Natal in 1850, was appointed as curator in 1851 and the register refers to the period 1865–1872. It is learnt from this that McKen sent Natal plants throughout the world, to the public gardens of Hongkong, Mauritius, Australia and Europe. In the last seven years of office before he died he despatched overseas no less than 670 specimens of *Encephalartos*. His records show that on 22.2.1867 a consignment of 25 specimens of *Encephalartos* from Umtwalumi was sent to Ambroise Verschaffelt, Gent, Belgium, (Lemaire's nurseryman friend), 12 more on 29.2.1868 from 'Krans Kloof', 50 on 20.7.1868 and others on later occasions.

E. villosus Lem. is still common in Natal and there is little doubt that most, if not all of the specimens sent from Umtwalume, about 50 miles south of Durban, on 22.2.1867, were of this species and either this or some earlier consignment probably contained the specimen or specimens on which Lemaire founded the name in that year. It is significant that McKen used the name *E. villosus* (*villosa*) for the first time when dispatching four specimens from "Krans Kloof" to Melbourne on 15.2.1869.

It is necessary to add that McKen later dropped the name *villosus* and refers to *E. mackenii* in his register. The name *E. mackenii* was used in synonymy by Miquel in 1869, for a garden plant which he identified with *Macrozamia pauli-guilielmi*, and was used again by G. Henderson in his Ill. Dict. Hort. 508 (1885). The description in the latter agrees with our conception of *E. villosus* Lemaire, for which reason the name is regarded as a synonym of this.

Encephalartos ghellinckii

This species was described by Lemaire in 1867 at the same time as he described *E. villosus*. Since *E. ghellinckii* is restricted in its natural distribution almost entirely to Natal and in view of the strong circumstantial evidence in support of the suggestion that McKen was instrumental in supplying the type material of *E. villosus* Lem. from Natal, there is good reason to suggest that McKen also had a part in sending the type material of *E. ghellinckii* Lem. from Natal to the nursery garden of Verschaffelt, where it was studied by Lemaire.

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A NEW SPECIES OF HAWORTHIA

C. L. Scott

(*With Plates XXI and XXII*)

Haworthia geraldii C. L. Scott sp. nov. (LILIACEAE—ALOINEA) Sect. RETUSA.

Rosetta. Acaulescens, 10 cm. diam; basi prolifera.

Folia. 18 juniora erecta, seniora patula, recurvata. ad 6 cm. longa, 30 mm. lata, 25 mm. Crassa, per 80° recurvata.

Pars retusa. 30 mm. lata, 23 mm. longa, plana lineis 8—12, et maculis elongatis albides instructa, circiter 1 mm. longus, pellucida viridi.

Subtus. Convexa, glabra, pallide viridia, seta extrema 3—6 mm. longe, persistante, pellucides. Margines et carina dentibus pellucides, minutis instructi.

Pedunculus. Simplex, gracillimus 2 mm. diam. 27 cm. longus, racemo incluso, claro-fuscus.

Racemus. 20 cm. longus, flores 20; 4 apertus.

Pedicelli. 2 mm. longi, 2 mm. diam.

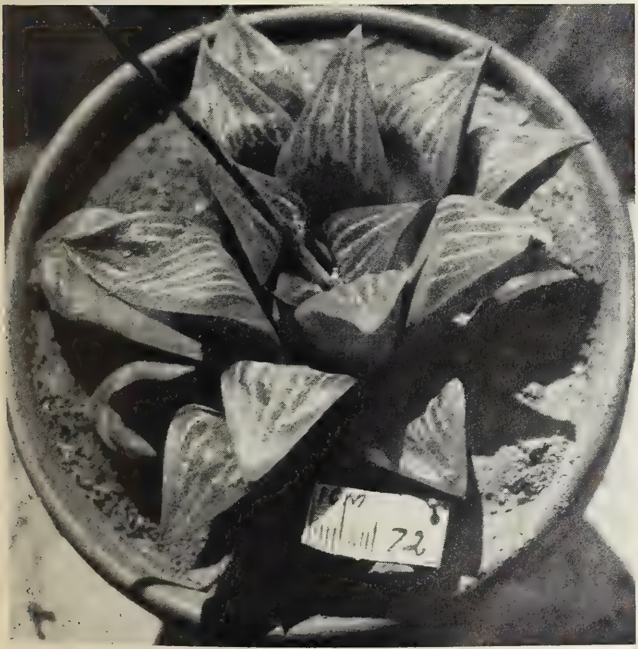

Fig. 1.

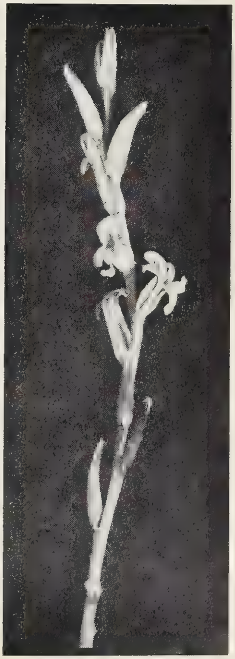

Fig. 2.

PLATE XXI

Haworthia geraldii C. L. Scott. 1. Plant. 2. Inflorescence × $\frac{3}{4}$.

Bractea fertilis. 6 mm. longae, delta.
Bractea steriles. 20 circiter, 9 mm. longae.
Perianthium. Albidum, 13 mm. longum.
Stamina. 5 et 6 mm. longa.
Ovarium. 4 mm. longus, 2 mm. diam; viride.
Stylus. 1 mm. longus, curvatus, capitatus, albido.

DESCRIPTION

Rosette acaulescent, up to 10 cm. in diam; Proliferous from the base and forming clusters.

Leaves. About 18, the young erect with the older spreading retused at an angle of 80 degrees, firm, up to 6 cm. long, and up to 30 mm. broad, 25 mm. thick measured at the base of the end area; *face below end area*; flat below, to concave above, smooth pale green, not shining.

End Area up to 30 mm. broad, and 25 mm. long, turgid, 8—12 pale green parallel face lines, with the middle one nearly reaching the tip, the others progressively shorter. The parallel lines are flanked by short longitudinal

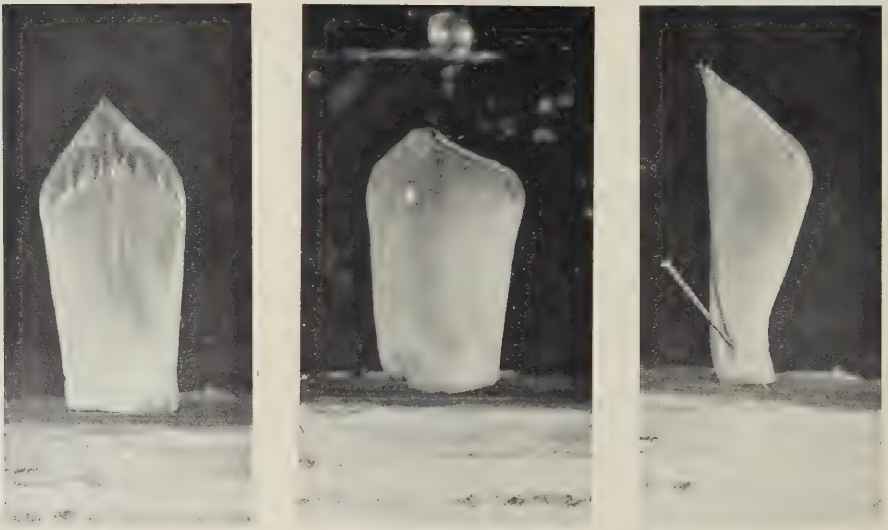

PLATE XXII

Haworthia geraldii C. L. Scott. Leaf: 1. Front, 2. Back, 3. Side.

white flecks about 1 mm. long giving them a whitish appearance; pellucid green, shining, with raised small pellucid tubercles, deltoid at tip, ovate, oblong.

Back. Keel in upper $\frac{1}{3}$ acute, with a few pellucid teeth spaced about 1 mm. apart on keel. Lower $\frac{2}{3}$ very rounded margins acute very minutely toothed up to half way below base of tip area.

End Awn 3—6 mm. long; persistent, reddish brown at base and middle, dull white at tip.

Peduncle. Flattened low down; simple, terete, 2 mm. in diam. and up to 40 cm. long including the raceme, light brown, sterile bracts about 20, 9 mm. long, the lowest 20 mm. from base of the peduncle;

Raceme up to 20 cm. long 2 mm. in diam. 20 spirally arranged flowers and buds, 4 open simultaneously.

Fertile Bracts. Bracts 6 mm. long, deltoid acuminate, white, papery, with a fine dark brown nerve.

Sterile Bracts. 20, up to 9 mm. long, white, with reddish brown nerve.

Pedicels 2 mm. long 2 mm. in diam. dark green.

Perianth. Greenish white, 13 mm. long. the cylindrical triangular base swelling 4 mm. in diam; constricted above ovary to 3 mm, ascending, straight. Segments free.

Upper Segments recurved about 90 degrees, channelled; face colour of inner segment pinkish white, with a broad light green nerve, narrow, obtuse, colour below, green. Face colour of the two outer, pinkish white, with a broad light green nerve; acute.

Lower Segments more recurved, face colour of inner segment pinkish white, with a fine greenish brown nerve, channelled, narrow; obtuse, face colour of two outer segments, white with a broad green nerve; deeply channelled, spreading, colour below, green.

Stamens 5 and 6 mm. long.

Style. White, 1 mm. long; at length exserted, ovary 4 mm. long 2 mm. in diam; green. Bent, capitate.

Type (C. L. Scott 72) in Nat. Herb. Pretoria.

Type locality. Cape Province; Riversdale District.

Distribution. Not further known.

This species is described from material collected by the author. It occurs on a very dry and stony hill, and under bushes in clusters up to 6 rosettes, to the east of Riversdale.

The plants grow well raised from the ground and are found in dense patches, and very proliferous from the base.

Compared with the accepted form of the species *Haworthia retusa* as accepted by Berger p. 100 in Das Pflanzenreich of 1908:—it is allied to that species in that the peduncle and raceme is the same in length and colour, it has the same number of sterile bracts, it is similar in shape and habits, and occurs in the same division. It has characters by which these two plants can easily and accurately be separated.

It is a much larger plant, with longer, broader and thicker leaves and more face lines on the end area. Minute teeth on both margins and keel, with the longitudinal white flecks more numerous on the face of the end area.

It has no reddish marks on its back or reddish nerve along its margins as in the case of the accepted *Haworthia retusa.* It has a much longer end awn, and is the most proliferous of all the described plants in the *Retusa* section. It is readily and easily identified by the large clusters it soon forms.

I have much pleasure in naming this attractive plant in honour of Mr. Gerald Graham Smith of the East London Museum for his excellent contribution to the genus Haworthia.

A RAPID AND SIMPLE METHOD FOR MEASURING THE EVAPORATING POWER OF THE AIR

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Introduction

A quantitative assessment of environmental factors is essential in modern ecology. Water is undoubtedly the most important factor in many habitats and an understanding of the water relations of vegetation is of the utmost importance, if the behaviour of the plants in the field is to be understood.

The ecologist is interested particularly in the evaporating power of the air, as it gives an insight into the water relations of plants. In general, he does not measure it frequently, as the conventional measuring methods are time-consuming and the calculation of evaporating power is complex and not necessarily accurate. However, evaporating power of the air yields more information on plant behaviour than either temperature, relative humidity or vapour pressure deficit measurements. The evaporating power of the air varies markedly, even between neighbouring communities where temperature differences may be slight.

This paper describes a simple and rapid method for measuring evaporating power of the air. No high degree of accuracy is claimed for this method and the complexity of the process of evaporation, especially in vegetation, is appreciated, but it notes the major factors involved and is very rapid. It makes possible the introduction of measurement of evaporating power of the air as routine background investigations in ordinary ecological work and on brief excursions in the field it enables comparative work on environmental factors to be undertaken.

To determine the evaporating power of the air, the following must be known:—*temperature*, *relative humidity*, *wind speed* and *barometric pressure*.

Temperature can be measured by an ordinary thermometer. Relative humidity is determined by wet and dry bulb thermometers, hair hygrometers or dew point apparatus. Wind speeds are readily measured by small portable anemometers, and barometric pressure can be measured by small aneroid barometers. All these measurements can be readily and rapidly made with equipment which is normally carried in the field.

Many ecologists collect humidity, temperature and wind data in the field, but due to the complexity of the calculations involved, make no effort to correlate these. As a result, they may easily overlook interesting aspects of the problem they are studying. Using the alignment chart (Fig. 1), it is possible to read off the evaporating power of the air in the field without any calculations, as long as the temperature, relative humidity, wind speed and barometric pressure are known.

Alignment Chart

This is a triple alignment chart, best drawn on a paper of foolscap size. On the left, the alignment of temperature (T) and relative humidity (R) gives the vapour pressure deficit (V) of the air. On the right, the alignment of barometric pressure (B) with the wind speed (u) gives the evaporation of water per unit area per millimeter of mercury difference in vapour pressure (e). By aligning (V) and (e), the evaporating power of the air (E), expressed in kilograms of water lost per square metre per hour from an open surface, can be read directly. This is the rate at which a free water surface would lose water under these conditions.

To simplify the process of reading the chart, a transparent ruler with a straight line engraved on it can be used.

Construction of the Alignment Chart

The first stage in the construction of the chart is to depict the relationship of temperature, relative humidity and vapour pressure deficit. If P is the pressure of saturated water vapour at any temperature T, and p is the partial pressure of water vapour at that same temperature and relative humidity R per cent, then the vapour pressure deficit V or (P–p) is equal to P (1-0·01R). Thus, a temporary log scale of P in millimetres of mercury and a permanent log scale of V in the same units are plotted as parallel lines. The number of inches per cycle in the log scales depends on the range of values contemplated and on the size of diagram desired, whereas the distance apart of the scales depends only on the size of the diagram. For instance, 8·87 in. and 4·23 in. per cycle respectively, and 2 in. apart serves in this case to secure a reasonable range of V. The third scale for (1-0·01R)—subsequently graduated in values of R—is created by inersection of related values on the P and V scales, or by calculating the position of some key points on it and graduating between them. The last step in this stage is to graduate the temporary log scale of P in terms of °C or °F, using a table of values of saturated vapour pressures against temperatures and erasing the unwanted P graduations.

The second stage is to relate evaporation in grams per square metre per hour per millimetre of mercury difference in vapour pressure (e) to wind velocity in feet per minute (u) and barometric pressure in millimetres of mercury (B). A simple relation of the form

$$e=(K/B)\,(1+u/m)$$

is acceptable for this purpose, where K, 1 and m are constants, assigned a value of 23,400, unity and 452 in this case (2), wherein the constant 23,400 refers to wind tunnel conditions, as in laboratory work, but may be amended for other condition, giving proportional adjustments in the value of (e) from the diagram. The same technique as above is used to construct the scales. It was convenient to establish log scales representing (e) at 7.6 in. per cycle and (B) at 39.5 in. per cycle, 2.5 in. apart and to construct the scale of (u) by intersection, in the first place in the form 23,400 $(1+u/452)$, later graduating in values of (u). This method appears to be easier here than calculating the position and dimensions of the (u) scale.

The third and final stage resembles the first. In the 2·5 in. left between the other two parts of the diagram is placed the scale (E), expressed in units of kilograms of water per square metre per hour, essentially a product function of the scales for (e) and (V). It may therefore be placed and graduated by intersection or calculation.

The use of the Alignment Chart

The uses of this chart vary, depending on the requirements of the experiment, but the following illustration may clarify how it can be used in ordinary ecological work. Some investigations were conducted in Happy Valley, Bain's Kloof, Cape Province, South Africa. A small stream flows down this mountain valley, and is flanked by a community of dense *Riverine Shrub* which is 10—25 ft. wide and about 5—7 ft. tall. This changes suddenly into a flat alluvial plain, the *Restionaceous Plain*, which is from 75—100 ft. wide. This gives way to a steep rocky slope covered in *Protea Shrub.* Despite their close proximity, these communities are distinct in general appearance and floristic composition. The small size of the valley makes it an admirable site for many ecological investigations, particularly for micro-climatic comparisons. Table I shows some of these. The figures cited are typical and no effort has been made to select a special set of readings which might be particularly easy to interpret.

The *Riverine Shrub* undoubtedly retains pockets of warm air over long periods and hence temperatures are frequently warmer than in the other two neighbouring communities which allow the free passage of air currents. Vigorous gusts of wind can, however, blow these warm air pockets away. Although transpiration is active and there is no shortage of water, insolation of the trapped air pocket may result in the relative humidity being fairly low in this vegetation. As Table I shows, the evaporating power of the air may be quite high. In fairly cool weather, the air of the *Riverine Shrub* is warmer than that of the other communities. Due to lack of constant wind, the evaporating power of the air is usually appreciably less than in the other communities. Both the *Restionaceous Plain* and the *Protea Shrub* are much drier environments for plants, even in cool weather when the temperature of these is usually lower than that of the *Riverine Shrub.* This can be expressed quantitatively and without the need for weighty apparatus which is usually considered necessary for such investigations. It can be demonstrated that one community exists in a "drier" environment than another close by and a rough quantitative comparison can be made.

Drawbacks to the Chart

The main drawback to the chart is that it cannot be used at temperatures around freezing. In very humid surroundings relative humidities of over 95% cannot be measured accurately in the field by any ordinary technique. This chart was not designed for accurate and detailed investigations of evapo-transpiration, and does not attempt to assess factors such as radiation, or the more complex influence of multidirectional winds on evaporation. Investigation shows that under certain conditions there is a tendency to overpredict the evaporating power of the air (1). Nevertheless, because it gives a rapid and reproducible index of the evaporating power of the air, it is of real value to the ecologist, who has no other rapid and reproducible method available as yet.

SUMMARY

The construction of an alignment chart which enables the effect of temperature, relative humidity, wind and barometric pressure to be integrated to give the evaporating power of the air rapidly in the field is described. A brief example of its use is given.

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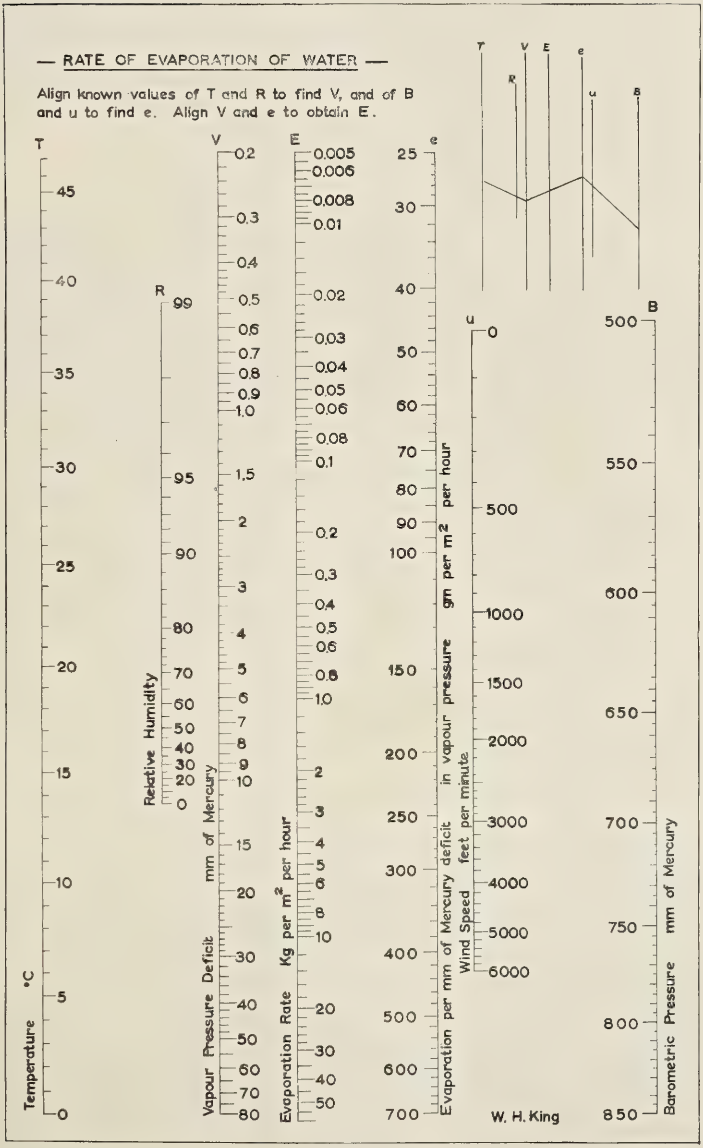
TABLE I

Physical data on the air at 3ft. from the ground in Happy Valley on 22.9.1960. Barometric Pressure 750 mm. Hg.

Community		T	R	e	E
I	10.45 a.m.	23	45	125	0·44
	11.45 a.m.	15	46	40	0·23
	12.45 p.m.	17	40	66	0·29
II	11.00 a.m.	14½	41	327	0·36
	12.00 noon	14½	43	650	0·48
	1.00 p.m.	19½	35	186	0·45
III	11.15 a.m.	14½	51	264	0·28
	12.15 p.m.	15½	38	490	0·50
	1.15 p.m.	16	40	275	0·40

Community I.	Riverine Shrub.
Community II.	Restionaceous Plain.
Community III.	Protea Shrub.

T = temperature in °C to the nearest half degree.
R = per cent relative humidity.
e = wind velocity in feet per minute.
E = evaporating rate in kilogram of water per square metre per hour.



— RATE OF EVAPORATION OF WATER —

Align known values of T and R to find V, and of B and u to find e. Align V and e to obtain E.

FIG. 1

REFLECTIONS ON THE DEVELOPMENT OF POLLINATION SYSTEMS IN AFRICAN PROTEACEAE

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In a discussion of developmental lines in pollination of South African *Proteaceae* (sub fam. *Persoonioideae*) it is advisable to separate between *Mimetes* and the other genera. There is a very striking difference in gross shoot morphology between them, with the small, lateral inflorescences of *Mimetes* on one hand and the larger, terminal ones of the rest of the genera on the other.

It is difficult to suggest definite developmental lines within the subfamily. The large terminal inflorescences of *Protea* and *Leucadendron* with their specialized involucrum certainly represent an advanced stage, whereas the smaller, subterminal inflorescences of *Serruria* and *Diastella* with no or indistinct involucrum indicate themselves as being more primitive. If this reasoning is continued, backwards as it were, one should arrive at the conclusion that *Mimetes* should represent an even more primitive stage. This genus is the only one in which the main branch is apparently able to grow on after flowering because the terminal growing point is here not consumed with the formation of the inflorescence, as in the other genera.

An interesting case is represented by *Paranomus*, which has a terminal inflorescence, like the *Protea* type. But this inflorescence—which has no common involucrum—is bi-axial, like the *Mimetes* anthocladium, only the bracts are not foliar and do not function after anthesis. The question can be raised if the ordinary terminal inflorescences might also be bi-axial, like that of *Paranomus*, only more compressed. It does not appear to be the case, and even *Spatalla* seems uniaxial, notwithstanding its similarity with *Paranomus*.

The most reasonable developmental lines seem to lead from a branched system of dispersed, small inflorescences (cf. the position of the male inflorescences of *Leucadendron plumosum* cf. Johnson and Briggs 1963 : 56). These, in the simplest case, contracted to the subterminal condition seen in *Mimetes* or, alternatively, to the similar, but terminal position seen in *Paranomus*. Another line of development leads to larger inflorescences, terminal on lateral branches in more primitive genera, terminal on the main branch in *Protea*, *Leucadendron*, etc. When inflorescences are still comparatively small (*Serruria*) a number of flowering lateral branches form underneath last year's inflorescence, but when they are greater (*Protea*, *Orothamnus*), the branching is more sparse, and, on the whole, each main branch only produces one inflorescence.

Another development leads to uni-sexual inflorescences. This seems to be a final refinement, occurring only in genera with a large, terminal inflorescence: *Leucadendron*, *Aulax*. At any rate, these genera must be considered the most highly evolved within the subfamily.

For lack of material, I shall not comment upon *Faurea*. If the shrubby habit of most Cape *Proteaceae* is considered an adaptation to the "Fijnbos climate", the stature of *Faurea* is more in keeping with that of the assumed forest-inhabiting ancestors and in that respect the genus should represent a primitive condition, which is also in keeping with its distribution pattern and assumed antiquity (cf. Levyns 1963). However, its inflorescences are highly evolved: terminal, deciduous catkins. Within *Mimetes*, there is a development from the radiate, not very highly specialized inflorescences of *M. hirta* to those remarkable ones of *M. hartogii*, which have already been described by Vogel (1954 : 183). In this species (and *M. lyrigera*?) the inflorescence is half enclosed by the edges of the bract belonging to the next inflorescence above, bent backwards in such a manner as to form a gullet-shaped pseudanthium, not unlike the one in *Acanthus*, in which, however, the (pseudo-) galea is formed by one of the sepals of the same flower.

The *Mimetes*' bracts are more leaf-like than those of other genera, and, as far as I could make out, the growing point of the flowering branch is not consumed by the formation of flowers, but goes on vegetatively after anthesis. *Mimetes* would then have an anthocladium, not an inflorescence. It is also interesting to see how the bracts of *M. hartogii*, which first are part of the attraction apparatus of the blossom*, later turn green and apparently take over ordinary assimilatory functions.

In *Leucospermum* the terminal inflorescence is loosely organized and functions as a brush blossom. In the more highly developed genera, the progressive development of the inflorescence, especially of an involucrum underneath, transforms it into the more primitive bowl-shaped blossom type. In *Leucospermum*, the individual florets constitute the only optical attraction of the brush blossom. In *Telopia* (Australian) the deep red involucrum is not very prominent, and the equally strongly coloured florets still form the major means of optical attraction. Within most *Protea* species the involucrum gradually takes over this function. In some species, e.g. *P. arborea* or *P. tottum*, the involucrum is rather insignificant, and the florets are as important optical attractants as in *Telopia*. In others, like *P. cynaroides*, the involucre is very prominent, and the inflorescence forms a firmly organized bowl-shaped blossom.

This tendency towards the formation of a secondary, open blossom is even more prominent in *Leucadendron*, in which genus the florets, still well developed in *Protea*, are very much reduced and form a dense column in the middle of the blossom, the main optical attractant of which is formed by the involucrum. Also here there is a gradual development from the rather insignificant involucrum in *L. argenteum* towards the more prominent one of most species. The aberrant male inflorescences of *L. plumosum* have been mentioned already. It must remain undecided whether they represent a primary primitive condition, or a secondary development.

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* *Blossom* is here used for the functional unit, notwithstanding its morphological value, opposite *flower* which is used as the morphological term, cf. Faegri & v.d. Pijl 1964.

Unfortunately, little is known about the pollination of *Proteaceae*, but a few points are known. Even to the most casual observer ornithophily is obvious, and already in the more primitive anthocladia of *Mimetes* the ornithophilous syndrome is clear: the small lateral inflorescences form brush blossoms of a very regular type. Bird visits have been recorded by Marloth (1901). The contrast between the primitive shoot morphology and the extreme specialization of the inflorescences is indeed striking.

No information seems to be available concerning pollination in *Faurea* and similar genera. The syndrome indicates entomophily. On the other hand, it is reported by seedsmen and breeders that birds are very important pollinators of the loosely organized heads of *Leucospermum*. According to available information the crop of *Leucospermum* seed is directly dependent on the frequency of pollinating birds during the flowering season. However, these brush blossoms are also visited by many other animals, of which the smaller, e.g. hive bees, seem to be able to reach the nectar without making contact with the stigmas (observed along the road near Stellenbosch). They must therefore be considered nectar thieves. But a large, green beetle, *Trichostetha fascicularis* which is known to visit these blossoms (observed in Kirstenbosch gardens), undoubtedly brushes against both stigmas and anthers when it lands on the heads, and probably also pollinates the inflorescences, even if a direct proof has not been given.

Birds are very active feeders in *Protea* blossoms and there is no doubt that they are also important pollinators. According to information, the long-tailed sugarbird, *Promerops cafer*, usually nests in *Protea* bushes and also takes practically all its nourishment from them. The narrow inflorescences of, e.g., *P. repens* (*P. mellifera*) are hardly negotiable by larger insects which would find great difficulty in entering between the massed styles. On the other hand the stiff involucral bracts certainly form very suitable perches for pollinating birds whose beaks reach the bottom of the inflorescence. As to the quantity of nectar available, the synonym as well as its popular name, "sugarbush", are sufficiently indicative. Observations show that *P. repens* is pollinated by birds.

When it comes to the open, bowl-shaped *Protea* blossoms, of which *P. cynaroides* has been quoted as an example, it is evident that they can be utilized by many nectar and pollen collecting animals. They are visited by birds, bees, and beetles alike, and as their seed-setting (always irregular) is reported not to show such a close correlation to the occurrence of sugar-birds as in *Leucospermum*, it is not improbable that other groups are, at any rate partly, effective as pollinators.

In *Leucandendron*, the organisation of the blossom indicates that the pollinator should be short-tongued animals. Apparently, the black beetles *Genuchus hottentottus* (observed on Table Mountain), is an effective pollinator of these blossoms. To which extent they are also visited by other insects is unknown: the beetle, on its part, is not restricted to *Leucadendron*, but was also seen in other blossoms of a corresponding organisation (e.g. *Clutia*).

Within *Proteaceae* there is thus a "retrograde" development of pollination syndromes from the brush blossom type back to the more primitive bowl-shaped one concomitant with the progressive morphological development of the blossom. This development is apparently accompanied by a similar "retrograde" development amongst the pollinators, from pure or predominating ornithophily back to the assumed most primitive stage of cantharophily.

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STUDIES IN CYPERACEAE IN SOUTHERN AFRICA: I

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ABSTRACT

Studies in Cyperaceae in Southern Africa were undertaken in order to obtain information that might lead to more unified treatment of the sedges of Africa than exist at present, and that might eventually aid in clarification of the many taxa that are both African and world-wide, or pantropic, in distribution. Natural classification of Cyperaceae is essential if, eventually, generic relationships are to be more correctly appreciated and better understanding of infra and inter-tribal relationships achieved. A review of relevant literature is given.

GENERAL INTRODUCTION

The study of Cyperaceae in Southern Africa was undertaken as a direct consequence of difficulties met with in naming sedges collected during the course of ecological studies.

In Natal, situated on the warm south eastern coast of Africa and with a range of habitats from coastal to high mountain, many species are available for field study.

Prominent are representatives of predominantly tropical genera, numbers of which reach the limit of their southern distribution in Africa, either in Natal, or in adjacent areas of the eastern Cape Province.

Represented also, particularly at higher altitudes on the mountains, are species of predominantly temperate genera that may be regarded as outliers of the Cape Flora (Levyns, 1964). Natal is thus conveniently situated as the centre for such studies.

It was thought probable that in undertaking investigations throughout southern Africa, facts concerning morphological variation, ecological preferences and distribution might lead to better understanding of relationships between tropical and southern African taxa and those of Africa and the rest of the world.

Within Cyperaceae, generic limits are by no means always clearly defined nor stabilised, nor are phylogenetic relationships fully understood. Detailed studies are thus also necessary if, eventually, generic limits are to be more correctly established and better appreciation of infra- and inter-tribal relationships achieved.

REVIEW OF THE LITERATURE

The first publications devoted exclusively to the Cyperaceae of Southern Africa appear to be the accounts by Nees von Esenbeck (Nees 1832; 1833; 1836) of the sedges collected by Ecklon. In the same year as the earliest of these, Schrader (1832) produced Part I, Cyperaceae, of his *Analecta ad Flora Capensem*, a small work in which forty nine species were described and twenty one figured. Kunth (1837) included a large number of Cyperaceae from Southern Africa in his systematic treatment of all the then known Monocotyledons. Of this work Bentham (1881) wrote, " . . . his monograph, forming the second volume of his *Enumeratio Plantarum*, is very much to be relied upon in everything that he states on his own authority. His chief errors are sometimes a tendency . . . to give as characters rather what in theory we ought to see rather than what we actually do see, and . . . to describe specimens rather than species".

Von Schlechtendal (1840) discussed the species of *Carex* in Schulte's edition of Thunberg's *Flora Capensis*. Steudel (1855) described many Southern African species, but did not limit his work to the sedges of this sub-continent. He was rather severely criticised by Bentham (l.c.) in the following comment, "Steudel came next with his *Synopsis Plantarum Glumacearum* which would have been a very useful work if he had had any idea of what constitutes a species or a genus. Wherever he could not readily determine a specimen he had before him, he at once described it as new, thus adding in no small degree to such confusion as Nees and others may have created".

In the period from 1855 to 1867 no major contributions to the knowledge of Southern African Cyperaceae were made. Some additional descriptions based for the most part on material collected by Drége appeared, but these were not many. The following ten years were important however, for it was during this time that Boeckeler (1867–1877) completed his survey of the Cyperaceae represented in the Royal Herbaria of Berlin and of other collections lent him for this purpose. This survey embraced almost every Southern African sedge then known. Boeckeler, according to Bentham, (l.c.) " . . . has verified a number of synonyms, and often successfully rearranged some of the species of the larger genera. His labours, however, would have been much more useful if he had had access to more of the works where Cyperaceae had been described; if he had not indulged so much in page-long uncontrasted diagnoses, if he had had rather a clearer idea of the principles upon which generic and ordinal distinctions are founded, and if he had adopted a more correct terminology."

There followed a further barren period which terminated with the publication of Vol. V, Monocotyledons, of Durand and Schinz's *Conspectus Florae Africae*. In this, the listing by Clarke (1895) of all the known African Cyperaceae, together with synonyms and the citation of specimens, was a considerable step towards a broad appreciation of the sedges of Southern Africa. In the light of more recent knowledge the work is not without errors, particularly those relating to the delimitation of species, but it is still a valuable reference.

Clarke was to make further extremely important contributions to the literature in the years that followed. His account (Clarke, 1898) of the species of South Africa, with its detailed descriptions, notes on distribution, keys to identification and the citation of specimens, is still the most reliable guide available to those attempting to know the Cyperaceae of this region. Mention must also be made of his treatment (Clarke, 1902) of the Tropical African representatives of the family. Although only four years separated the publication of these two works, it seems Clarke did not consider the species of both regions conjointly so that some relationships that might have been obvious had he done this, escaped him.

Clarke's contributions culminated in the publication two years after his death, of part of his manuscript notes of a monograph on Cyperaceae he had prepared (Clarke, 1908). Here were included descriptions of several new southern African sedges, while all others were listed in relation to their allies among world species. One year later, illustrations prepared by several artists under Clarke's direction to supplement the text of his monograph were published (Clarke, 1909). Appreciation must be expressed of this botanist's considerable knowledge of this varied and difficult family and of problems relating to its classification.

It is fitting at this stage to mention a second botanist who, during his lifetime, also contributed greatly to knowledge of world Cyperaceae, including in his studies many African species. This was Kükenthal whose monograph on world Caricoideae was published in Engler's *Pflanzenreich* (Kükenthal, 1909).

In the field of anatomical structure which, in certain families, aids in the elucidation of phylogenetic relationships, little has been done concerning the Southern African sedges. Plowman (1906) in his paper based largely on American species, dealt with the internal structure of the family as a whole. Despite its quality, this work did little to stimulate research on African material. Only two papers are known in which contributions to this field of study were made. Gibbs (1908) dealt mainly with the anatomy of *Fuirena oedipus* C.B.Cl., a Rhodesian species. Pfeiffer (1920) included with notes on floral structure, distribution and groupings of species and citations of specimens, a short account of the anatomy of *Ficinia* Schrad.

Two years later, Schonland's (1922) *Introduction to South African Cyperaceae* appeared. This added little to information already available. By selection of usually only a single species from each section of a genus, Schonland avoided the problem of differentiating among very closely related taxa. It is perhaps doubtful whether he realised fully the closeness of specific relationships within some of the genera, for in his citation of specimens, he propagated errors made originally by Clarke. No keys were included. During the preparation of this work, Schonland sent many specimens to Kew for identification or confimartion. He suggested several new species that were subsequently described, together with other new South African species, by Turrill (1925).

Brain, (1934) produced *A Key to the Sedges of Southern Rhodesia.* Although including useful ecological and distributional information, photographs and figures, this paper is neither complete systematically, nor without inaccuracies.

Twenty seven years after his first monograph, Kükenthal (1936) made his second great contribution to world knowledge of the sedges, by the publication of his comprehensive account of Cypereae. Here were included descriptions, distributional notes and citations of African species of *Cyperus* L., probably the most commonly represented genus throughout the continent. Because of probable phylogenetic relationships and difficulties in clearly delimiting genera, Kükenthal included in *Cyperus*, *Juncellus* C.B.Cl., *Pycreus* Beauv., *Mariscus* R.Br., *Kyllinga* Rottb. and *Torulinum* Desv. which were given sub-generic rank. It is to be regretted that the bulk of Kükenthal's material on which this work was based was destroyed during the second World War. Some duplicates still exist, however, and are available for study mostly in European herbaria.

In the years between these major works and in preparation for them, Kükenthal made other contributions to the knowledge of African, particularly Tropical African, Cyperaceae, but these must be regarded of lesser importance. (Kükenthal 1913–1937).

Since 1936, Levyns (1943–1947) has critically dealt with *Trianoptiles* Fenzl., a genus of three species endemic to the western Cape Province, and has considered certain aspects of *Scirpus*, *Schoenoxiphium* Nees, *Ficinia* and *Tetraria* Beauv., as well as having described new species within some of these genera. In 1950 this author (Levyns, 1950) was responsible for Cyperaceae in Adamson and Salter's *Flora of the Cape Peninsula.*

Nelmes, working at Kew between the years 1937 and 1958, (Nelmes, 1937–1958) described a number of African species new to science. Most of these were Tropical and West, rather than Southern African and included species of *Carex*, in which genus Nelmes was particularly interested. Within Cariceae he contributed facts and ideas relating to phylogeny, that differed from concepts held by previous workers (Nelmes 1952). He also revised the African species of *Coleochloa* Gilly, *Hypolytrum* L. C. Rich. and *Scleria* Berg. (Nelmes 1953–1956).

Recent appraisal of these revisions has shown them to be not without error. Their great importance is that they provide unified, reasonably comprehensive treatments of genera well represented in Africa, that previously had been dealt with only on regional bases. They have also undoubtedly stimulated interest in the Tropical African sedges in particular.

Most recent works on the Cyperaceae of Southern Africa are those of Podlech (1960) who dealt with South West African representatives and Bodard, (1963) who made a first contribution to the revision of *Bulbostylis* Kunth in Africa. In the last named work Southern African species are named but many have not been critically dealt with.

In the course of this review it must have become obvious that in dealing with literature relating to the sedges of Southern Africa, it is impossible and of little advantage, to confine references to the region south of the Zambesi River only. This is at best a convenient arbitrary boundary for the botanist, since many Southern African sedges have a distribution far beyond this river to north and to West Africa and often also to Madagascar, India, S. and Central America, and sometimes to Australia and the East Indies, for many species are cosmopolitan, or at least pan-tropic.

Many difficulties that arise in attempting to identify African sedges at the present time are the outcome of much of the early descriptive work having been undertaken on a regional basis, without due consideration for names already applied in adjacent territories, and with no regard whatever for variation that might occur within a species with continental distribution.

Bearing in mind these facts, from now on any worker on the Southern African sedges must consider literature relating to these plants throughout the continent, and when new species are described, to all other areas from which the genus is known.

In this review it is consequently both relevant and desirable to mention some of the more important works relating to Cyperaceae in other parts of Africa. Ridley (1883) dealt with sedges collected by Welwitsch in Angola. Many of these have subsequently been shown to be widely distributed in Eastern Africa where, in some cases, they were already known by earlier names.

De Wildeman (1926–27) described many new species from the Belgian Congo. Not all of these are still maintained, for this author did not check thoroughly against taxa previously described for Africa. During the course of modern continental surveys which, as Bodard (1963) has pointed out, are extremely necessary, more of these species will come under critical consideration. Peter (1936–38) described specimens from Tanganyika. In 1936 was also published the second volume of *Flora of West Tropical Africa* in which Hutchinson (1936) dealt with the Cyperaceae of this part of Africa. This work is now under revision at the Royal Botanic Gardens, Kew. Nelmes and Baldwin, (1952) in a short paper containing several illustrations, considered the sedges of Liberia and provided keys for their identification.

Useful keys and many illustrations are also provided in Tournay's treatment of the Cyperaceae of the National Albert Park (Robyns and Tournay, 1955).

Workers on tropical African sedges, if their studies are to be critical, will undoubtedly find their attention drawn to literature relating to Cyperaceae of other continents, for strong affinities undoubtedly exist between Tropical African sedges and those of some other parts of the world, Madagascar in particular.

It is thus admirable to find Bodard (1963) including reference to Chermezon's (1934) studies on the sedges of this island.

Robinson (1964) also found close relationship between some African and American species of *Scleria*. This author has carried out intensive field studies in N. Rhodesia and other parts of Tropical Africa and is now making most valuable contributions to the knowledge of *Scleria* in particular (Robinson 1961b–64).

Another recent contribution is the first paper in a series by Napper (1963) directed to knowledge of the Cyperaceae of East Africa. Keys to species and illustrations are provided.

Much remains to be done before the Cyperaceae of Africa become adequately known. Many taxa are most inconspicuous in the field and only careful searching in every part of the country will eventually disclose the wealth of species represented and their detailed distribution.

In considering the literature relating to the Cyperaceae of Southern Africa, no mention has been made of check-lists of local floras published from time to time. These lists frequently include sedges, but the information given is often not critical and sometimes false. Distributional data derived from such information cannot, in consequence, be without error.

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NOTES ON SOME SPECIES OF ERICA, WITH DESCRIPTIONS OF THREE NEW SPECIES AND TWO NEW VARIETIES

H. A. Baker

(With Plates XXIII — XXV)

1. E. pulchella Houtt.

This species is described in Flora Capensis as follows: "sepals oblong, lanceolate or linear-lanceolate, obtuse, keeled, very concave, scarious on the margin, ciliate, about 2 mm. long; corolla urceolate-campanulate, mouth slightly contracted, sub-tetragonous, glabrous, rosy or dark red, 3—4 mm. long, with the limb slightly spreading $\frac{1}{4}$—$\frac{1}{3}$ the length of the tube; anthers", etc. . . . Mr. E. G. H. Oliver recently collected a few specimens on a small saddle N.E. of Pringle Bay and to the East of the main road above the river valley that had campanulate flowers of a very dark red. The specimens were so unlike the typical form of *E. pulchella* in appearance that the author made a special visit to the site in 1962 to make a study on the spot.

In this small area only a 100 yards long and 20 or so wide, there is a colony of *E. pulchella* with a great diversity of corolla shapes and colours but, although the area is bounded on all sides by Ericaceous soil supporting a large variety of species, the diverse forms were, apparently, quite local. In considering corolla shapes it is interesting to speculate what is meant by "urceolate-campanulate" above. It would appear to be a contradiction of terms since urceolate, meaning urn-shaped is closing at the mouth, whereas campanulate, or bell-shaped is the reverse. Andrews in Col. Heath's No. 49 describes the flowers as "nearly globular" and has depicted them globose-urceolate. But his shapes are unreliable since they are from flowers grown in hothouse conditions in the U.K. Loddigers in Bot. Cat. t 49 figures the corolla somewhat variable in shape but mostly urceolate.

The most common and well known form from Stellenbosch to Caledon is that depicted in Fig. 1 (*a*), (*Baker* 1896) and collected in the area under consideration for comparison. The measurements of the various forms were actually made on the site and are, therefore, reasonably accurate. They show corollae ranging in shape from narrow-cyathiform to campanulate (Fig. 1 (*a*) to (*c*)). The forms in (*b*) and (*c*) stood out clearly from everything else owing to their very dark red colour; (*a*) was the normal rosy colour. It will be noted that, in addition to the corolla shapes, the sepals vary from less than half the length of the corolla as in (*a*) to three-quarters thereof, reaching to the base of

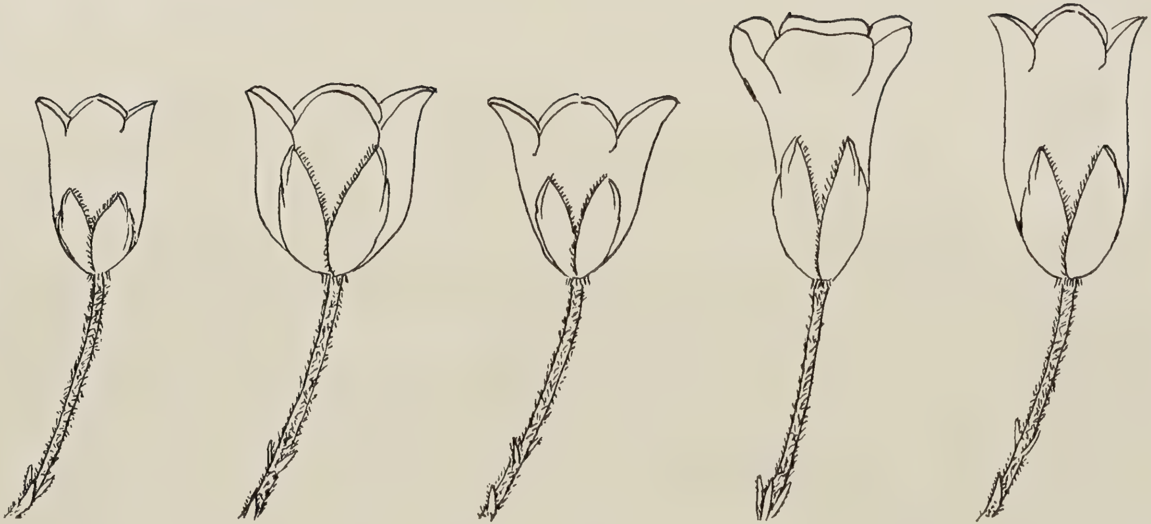

Fig. 1

a (1896)

b (1892 1888)

c (1894)

d E.longiaristata Benth.

e (850) ex. Bolus Herbarium

Erica pulchella Houtt. All X 3½. *Del.* H. A. Baker

(Numbers in brackets refer to authors' specimens) the lobes in some instances. This feature was variable even on the same plant. The lobes also vary considerably.

It is difficult to understand the reason for this great variety on such a small spot. There were no significant differences in other characters. In association were *E. corifolia* L., *E. pectinata* Kl. and *E. gysbertii* G. & B.

There is in the Bolus Herbarium a specimen in "incertae" collected by Stokoe in Feb. 1947 at "Rooi Els" which is very likely from the same locality as it resembles the forms under consideration.

It is interesting to compare *E. pulchella var. major* Salter, Fig. 1 (*e*), which is endemic to the area above Simonstown with *E. longiaristata* Benth., Fig. 1 (*d*), which was copied from a very beautiful pencil sketch on the herbarium sheet presumably from fresh material. The latter is widely distributed in the Bredasdorp Div. and the corolla is described as constantly wide-mouthed. It would appear, however, to be no more than a variety of *E. pulchella*.

2. E. **brachialis** Salisb.

For the record, a specimen has been found by the author at Hangklip with a "trunk" 30 mm. in diameter. It was 1·2—1·5 m. high and obviously of great age. There were many more of almost equal size.

3. E. **curviflora** L.

In the key to Evanthe in Flora Capensis this species comes in a section headed "Flowers solitary". This is not correct since it has been found with flowers 2-nate and 3-nate in several localities including the Cape Peninsula nature reserve, Bredasdorp and Ceres Divisions, in the latter with yellow flowers, (*Baker* 1476/7) Cape Peninsula, (*Oliver* 567) Ceres, Tafelberg 3,000 ft., flowers yellow, (*Baker* 1780) Bredasdorp nr. Pearly Beach. In each of the above the flowers are 1-, 2- or 3-nate on the same plant.

4. E. **fucata** Kl.

A colony has been noted on the lower slopes above Stanford in which the sepals are gamosepalous to a considerable degree (*Baker* 1815).

5. E. **cygnea** Salter

Collections in the valley above Rooi Els not very far from the type locality show considerable variation in shape, particularly of the corolla and anthers from the type (*Baker* 1667).

6. E. **macowani** Cufino

This has been found to be very variable in colour and not entirely reliable in the number of cells in the ovary; e.g. an all-yellow one from the Harold Porter reserve (*Baker* 1381), a pink/white form on Pringle Peak slopes (*Baker* 1408), very similar in appearance to *E. perspicua* growing with it; on dissection no hybrid characters were observed. Another form from a steep, slimy, clay bank above Betty's Bay had a pink/yellow corolla and a 4-celled ovary (*Baker* 1405). The bracts were also different, being very small and ovate. It appeared to be extremely local and is possibly a geographical mutation.

7. E. inops Bolus and **E. hispidula** L.

The former grows in profusion on the S.E. slopes of Constantia Berg about 700 m. and the latter is common on the northern slopes. In the small valley at 700 m. on that side the author collected forms of *E. hispidula* with 2 bracts approximate and 1 remote and some flowers with 1 bract (*Baker* 991 and 992), with 1 or 2 bracts (*Baker* 993), with 1 large, sepal-like bract adpressed to the calyx as in *E. inops* (*Baker* 996), 1 large bract approximate or remote and 1 cluster with no bracts (*Baker* 994), with 1 large sepal-like bract intermediate. (*Baker* 997), the peduncle rather long and the flowers pink and white, unlike the others mentioned, which were all white. These variable forms suggest hybridisation between these two very similar, wind-pollinated species.

Erica ionii H. A. Baker sp. nov. (*Ericaceae—Ericoideae*) Pyronium.

Frutex erectus ad 30 cm. altus, ramis multis subvirgatis e rhizomate vel basi stipitis ortis, junioribus pubigeris. *Folia* 3-nata, ovalia, circa 2 mm. longa,

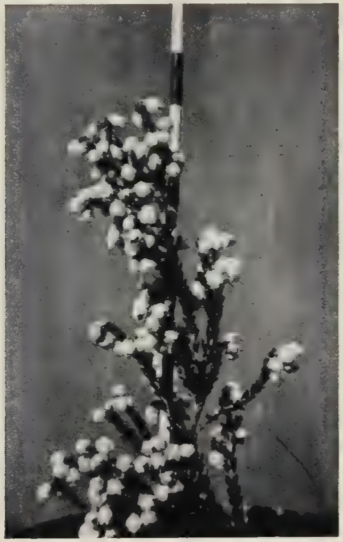

PLATE XXIII
Erica ionii H. A. Baker
The scale in the picture is divided into half inches.

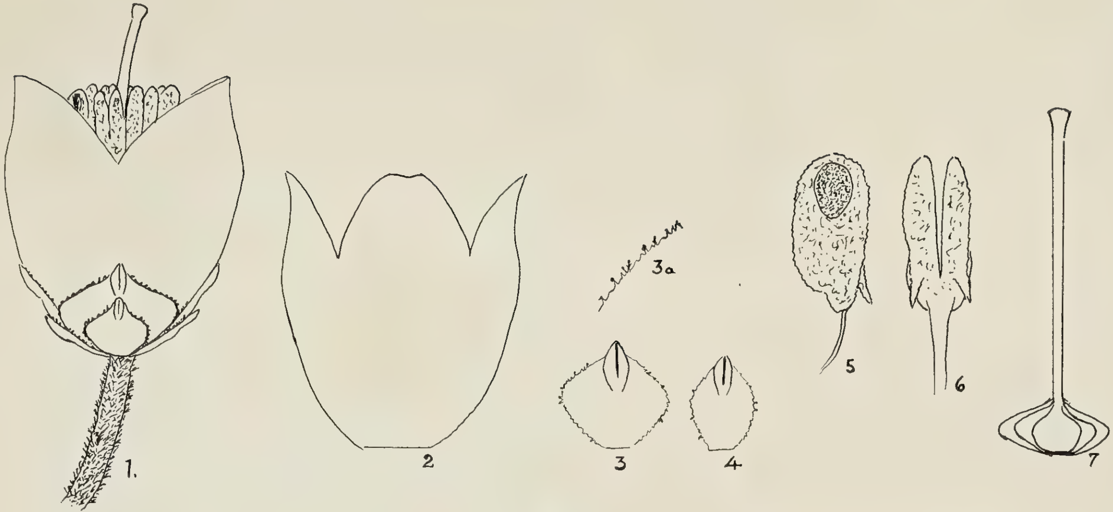

Fig. 2

Erica ionii H. A. Baker *Baker* 2330 1. Flower; 2. corolla; 3. sepal, 11 times 12; 3a. edge of sepal much enlarged; 4. bract × 6; 5. anther, side; 6. anther, back, both × 12; 7. gynoecium, × 6. *Del.* H. A. Baker.

ternata erecta vel leviter divaricata, primo imbricata sed demum internodis aequalia, superne concava nervo crasso, infra sulcata, glabra, marginibus serrulatis: petioli pubigeri. *Inflorescentiae* umbellatae 3—8-florae. *Pedicelli* 2 mm. longi, breviter hispidi. *Bracteae* 3, ovatae vel lato-ovatae, apice carinatae, scariosae, minute serrulato-ciliatae, 1·2 mm. longae, ad sepala arcte imbricatae. *Sepala* bracteis similia sed lato ovata ad orbicularia concava, fere 1·3 mm. longa. Pili pedicellorum et dentium marginalium bractearium et sepalorum interdum ramosi et rariori apice glandula minuta nigra. *Corolla* urceolata vix in faucibus constricta, sed variabilis secundum aetas floris, glabra, sicca, superne pallide rubicunda, infra fere alba, 3·5 mm. longa et 3 mm. lata: lobi erecti obtusi fere 0·75 mm. longi. *Antherae* laterales, tempestive manifestae, oblongae, basi lobo profundo, bipartitae, scabridae appendiculatae fere 1 mm. longae, poro tertia pars longitudinis lobi. *Filamenta* potius lata: aristae brevissimae, rugosae, liberae. *Ovarium* glabrum; stylo exserto, stigma capitellata.

An upright shrub to 30 cm. with many subvirgate branches arising from the rootstock or the base of the stem, the younger pubigerous. *Leaves* 3-nate, oval, about 2 mm. long, upright to spreading, imbricate at first, later about equalling the internodes, the upper face concave with a thick nerve, the lower sulcate, glabrous, the margins minutely serrulate, the petioles pubigerous. *Inflorescences* umbellate with clusters of 3—8 flowers. Peduncles 2 mm. long, shortly hispid. *Bracts* 3, ovate to broad-ovate, keel-tipped, scarious, coloured, minutely serrulate-ciliate, closely imbricating the sepals, about 1·2 mm. long. *Sepals* like the bracts but broad-ovate to orbicular, concave, about 1·3 mm. long. The hairs on the peduncles and the teeth on the margins of the bracts and sepals are sometimes branched and, in some cases have a minute black gland at the tip. *Corolla* urceolate, scarcely narrowed at the throat, the shape variable with the age of the flower; glabrous, dry, pale pink above to nearly white below, 3·5 mm. long, about 3 mm. wide; lobes upright, obtuse, about 0·75 mm. long. *Anthers* manifest at maturity, lateral, oblong, with a deep lobe at the base, deeply bipartite, scabrid, appendiculate, about 1 mm. long: pore one-third the length of the cell. *Filaments* rather broad. Awns very short, free, rough. *Ovary* glabrous; style exserted, stigma capitellate.

UNIONDALE DIVISION. On sandy slopes on Potjieskloof Pass beside the National Road from George to Uniondale at about 900 m. (3,000 ft.) *Williams* 245, *Baker* 2330, *holotype* in the Bolus Herbarium, and on the slopes of Hoopsberg about 11 miles west of Uniondale at 1200 m. (4,000 ft.) *Williams* 249. July 1962 and 1963. This plant was first collected by Mr. Ion Williams after whom it is named. He has, while collecting Leucadendron on which he is working, collected many Ericae for the author and he has a very good eye for un-named species.

E. ionii has been placed in the section *Pyronium* as it could easily be fitted into the key near *E. deliciosa*, but it differs from that species in most respects. In fact it cannot be said to be nearly related to any other species. It might be thought better placed in the sub-genus Chlamydanthe on account of its scarious bracts and sepals and their way of imbricating the corolla, but it will not fit into any section there on account of its umbellate inflorescence and comparatively small sepals.

The minute, black glands on some of the hairs and ciliations are interesting as their purpose is not clear. They are not sticky glands. Similar glands have been noticed on another species collected by Mr. Williams in this general area. This may turn out to be an un-named one too, but the material so far collected is too immature for a full study to be made. It is clear, however that it is of the same character, although it has muticous and differently shaped anthers and much larger sepals. It is hoped to collect mature specimens next year.

Erica pudens H. A. Baker sp. nov. (*Ericaceae—Ericoideae*) Pseuderemia.

Fruticulus parvus fere ad 15 cm. altus. *Rami* rigide hirsuti e rhizomate vel basi stipitis orti, primo erecti, tandem elongati et subprocumbentes fere 3 cm. super terram. *Folia* 4-nata lanceolata, fere 4 mm. longa leviter divaricata, primo imbricata deinde fere internodis aequantia, sulcata ad subplana, rigide hirsuta.

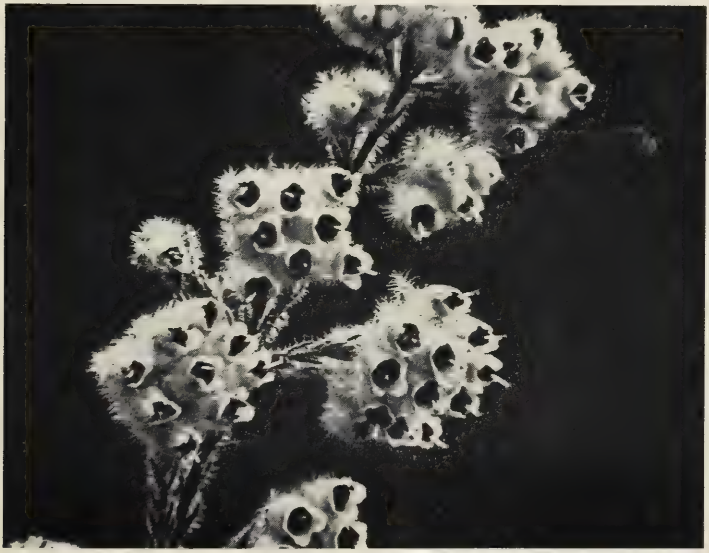

PLATE XXIV

Erica ionii H. A. Baker.
Approx. × 2

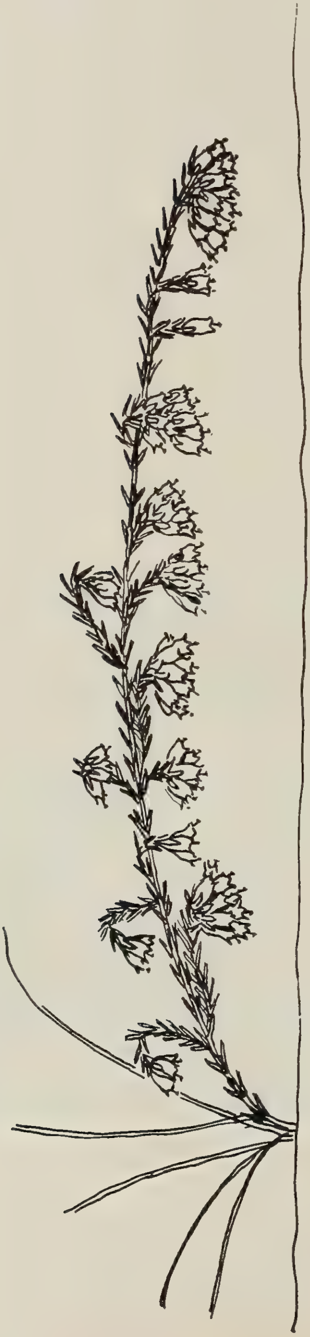

FIG. 3.

Erica pudens. Sprig, natural size, showing habit of older branches

Inflorescentiae cernuae capitatae, floribus ad duodecim directo declivibus. *Pedunculi* fere 3·5 mm. longi, idem bracteae et sepala rigide hirsuti crinibus fere 2 mm. longis. *Bracteae* 3, pilosae crinibus glandulosis, 2 approximatae et sepalis similes, tertia basalis lanceolata late sulcata, basin versus alba sed apicem versus viridis. *Sepala* pilosa crinibus glandulosis, anguste oblonga, e basi lata attenuata, 3 mm. longa, medio 0·5 mm. lata. *Corolla* tubulari-lanceolata, glabra, sicca, alba 4·5—5·0 mm. longa, lobis obtusis non extensis 1 mm. longis. *Antherae* inclusae vel demum tantum manifestae subdorsifixae, basi obtusae et lobatae alte bipartae scabrides appendiculatae, 1·3 mm. longae, poro fere tres partes longitudinis lobi: filamenta sat lata. *Cristae* latae laceratae 1 mm. longae, flavae. *Ovarium* glabrum; stylo exserto, stigmate capitata.

A dwarf shrub up to 15 cm. or so. Branches hirsute with stiff hairs, arising from the rootstock or base of the stem, at first upright then lengthening and becoming subprocumbent about 3 cm. from the ground with the flower heads

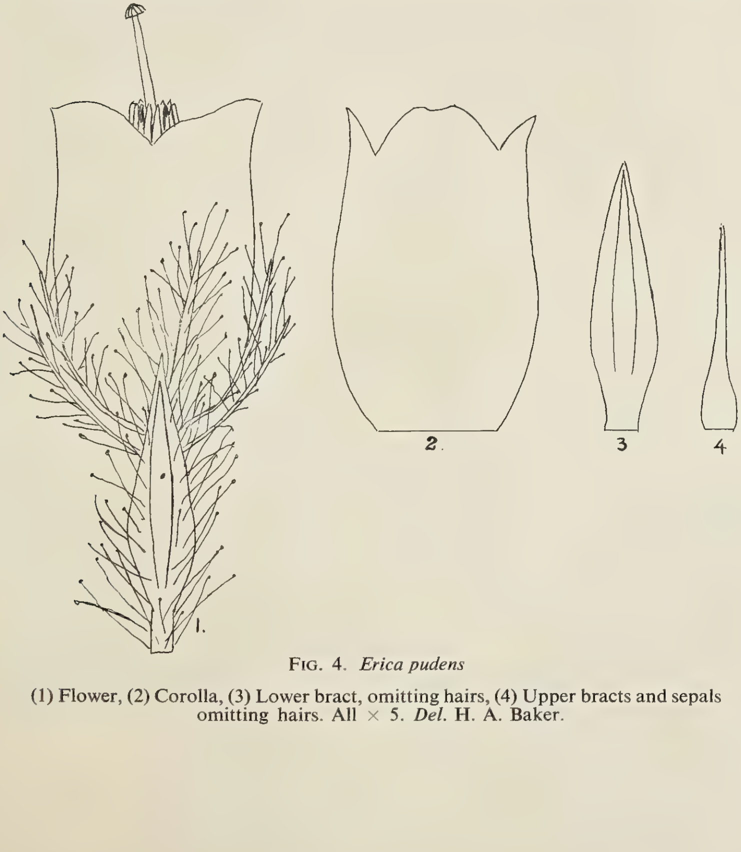

FIG. 4. *Erica pudens*

(1) Flower, (2) Corolla, (3) Lower bract, omitting hairs, (4) Upper bracts and sepals omitting hairs. All × 5. *Del.* H. A. Baker.

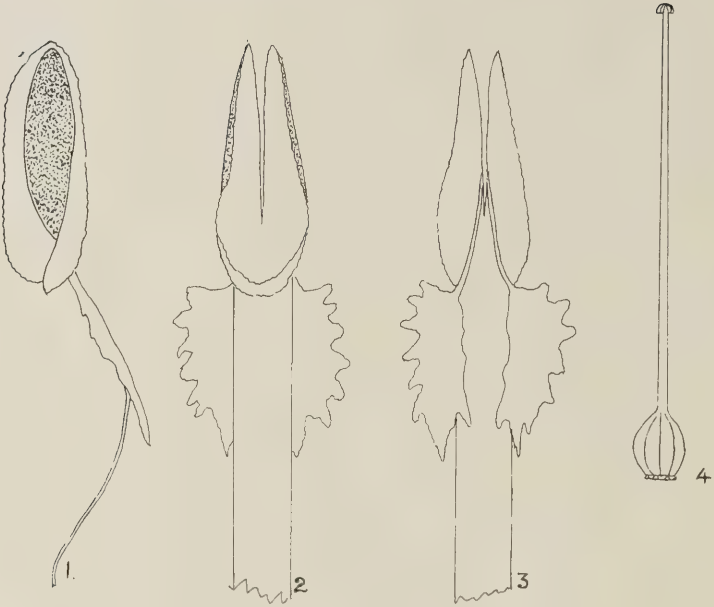

Fig. 5. *Erica pudens*
(1) anther, side view, (2) anther, front, (3) anther, back—all × 25, (4) gynoecium × 20. *Del.* H. A. Baker.

facing downwards. *Leaves* 4-nate, lanceolate, about 4 mm. long, slightly spreading, imbricate at first, later about equalling the internodes, sulcate to subopenbacked, hirsute with stiff hairs. *Inflorescences* cernuous, capitate in heads of up to 12 flowers. *Peduncles* about 3·5 mm. long and, like the bracts and sepals, hirsute with long, stiff hairs about 2 mm. long; those on the latter gland-tipped and viscid. *Bracts* 3, 2 approximate and sepal-like, the third nearly basal, lanceolate, widely sulcate, white towards the base, green towards the apex, 4 mm. long. *Sepals* narrow oblong, acuminate from a wider base, 3 mm. long, 0·5 mm. wide in the middle. *Corolla* tubular-urceolate, variable with age and position in the head, glabrous, dry, white, 4·5 to 5·0 mm. long: lobes not spreading, obtuse, 1 mm. long. *Anthers* included or just manifest at maturity, dorsifixed, cuneate, obtuse at the base and lobed, deeply bipartite, scabrid, dark brown, appendiculate, 1·3 mm. long; pore about three-quarters the length of the cell: filaments rather broad and more or less kinked at the apex. *Crests* broad, lacerate and more or less pointed at the base, 1·0 mm. long, yellow. *Ovary* glabrous; style exserted, stigma capitate with four horn-shaped processes.

Cape Province: Clanwilliam Division. Olifants Rivier Berge near Grasruggens at the summit of the Cardouw pass on the east side in pebbly clay. *Baker* 2350 *holotype* in the Bolus Herbarium. This plant has also been collected in this area by *Pillans* 8715, *Williams* 21, and *Lewis* 4053; at Warmbaths *G. Edwards* Sept. 1912; in Picketberg Div. *Esterhuizen* 16082; Ceres Div. on the twins, Mostert's Hoek, *Stokoe* 7127.

E. pudens was collected by the author as above on a hill side thickly populated by Protaceae and Ericaceae at about 2,000 ft. (600 m.). It grows to about 15 cms. in the centre of the plant and the outer branches gradually bend over and become almost procumbent with the flower heads only just above and facing the ground, hence the name meaning bashful or shy; these may grow to 45 cm. or so in length. It is interesting to speculate on the reason for this habit, which does not appear to afford protection from grazing but, rather, to offer its delights to some terrestial pollinator. Its nearest relative is, probably, *E. maderi* but it differs largely from this by (*a*) being procumbent, (*b*) having widely crested anthers, (*c*) gland-tipped hairs on the bracts and sepals, (*d*) much wider filaments and (*e*) being much more hirsute.

The various collections in the Bolus Herbarium in the "incertae" were examined and agree remarkably closely to the type and are undoubtedly the same species.

The author is indebted to Mr. Ion Williams for introducing him to this species which he collected in the same place.

Erica purgatoriensis H. A. Baker sp. nov. (*Ericaceae—Ericoideae*) Ephebus.

Fruticulus erectus ad 60 cm. altus. *Stipes* fere robustus ramis puberulis, plantis aliis paludosis implicatis. *Folia* 4-nata linearia, 2 mm. longa erecta vel divaricata, primo imbricata, denique remota, juniora hispidula glabrescentia. *Flores* numerosi ramulos breves terminantes, nunc solitarii nunc ad 4-nati. *Pedunculi* fere 2 mm. longi, hispiduli, bracteis parvis hispidulis remotis. *Sepala* aliquantulum in forma variabilia, plerumque lato-ovata, apice carinata subscariosa colorata, brevissime hispida et setoso-ciliata, 1·5 mm. longa. *Corolla* late urceolata, in faucibus leviter contracta, minute hispidula sicca, rubicunda, 3 mm. longa, 2·5 mm. lata, lobis leviter extensis obtusis 1 mm. longis. *Antherae* inclusae plus minusve oblongae, curvatae bilobatae et infra cuneatae, scabridae, appendiculatae 0·5 mm. longae, 0·25 mm. latae, poro parvo: aristae extensae setosae fere duo partes longitudinis cellulae. *Filamenta* angusta, propre basi affixa, apice leviter sigmoidea. *Ovarium* 4-cellulatum, 16-ovulatum, cylindricum super disco brevi et superne aliquantulum latius et hirsutum. *Stylo* incluso robusto, stigmate capitellatum.

Cape Province: Paarl Division. In a boggy marsh at the S.W. end of Franschhoek Pass on the property "Purgatory"; altitude about 1,000 ft. *Baker* 2374, *holotype* in the Bolus Herbarium.

Upright to 60 cm. or so; *stem* more or less stout, *branches* diffuse, intertwined and supported by the marsh vegetation, puberulous. *Leaves* 4-nate, linear, 2 mm. long, upright to spreading, imbricate on the flowering branches, later distant as the branches elongate, sulcate, the younger minutely hispidulous, glabrescent. *Flowers* numerous, terminal on short branchlets extending along the younger branches, from solitary to 4-nate. *Peduncules* about 2 mm. long, hispidulous, red; bracts remote, small, hispidulous. *Sepals* somewhat variable in shape, mostly broad-ovate, keel-tipped, subscarious, coloured, very shortly

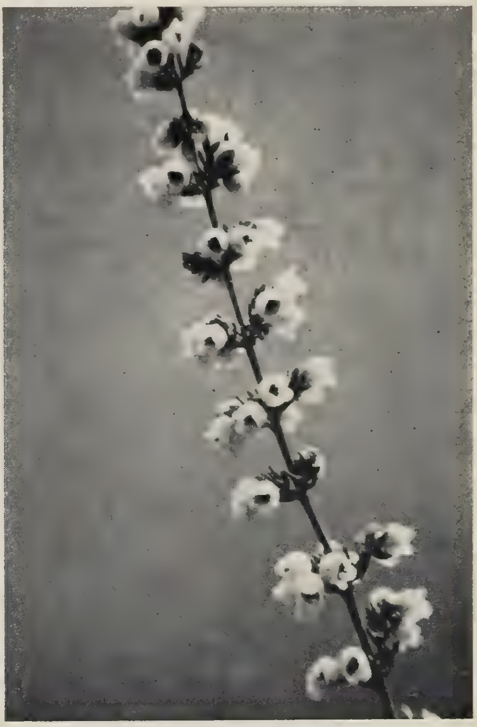

Plate XXV

Erica purgatoriensis H. A. Baker.
Approx. natural size.

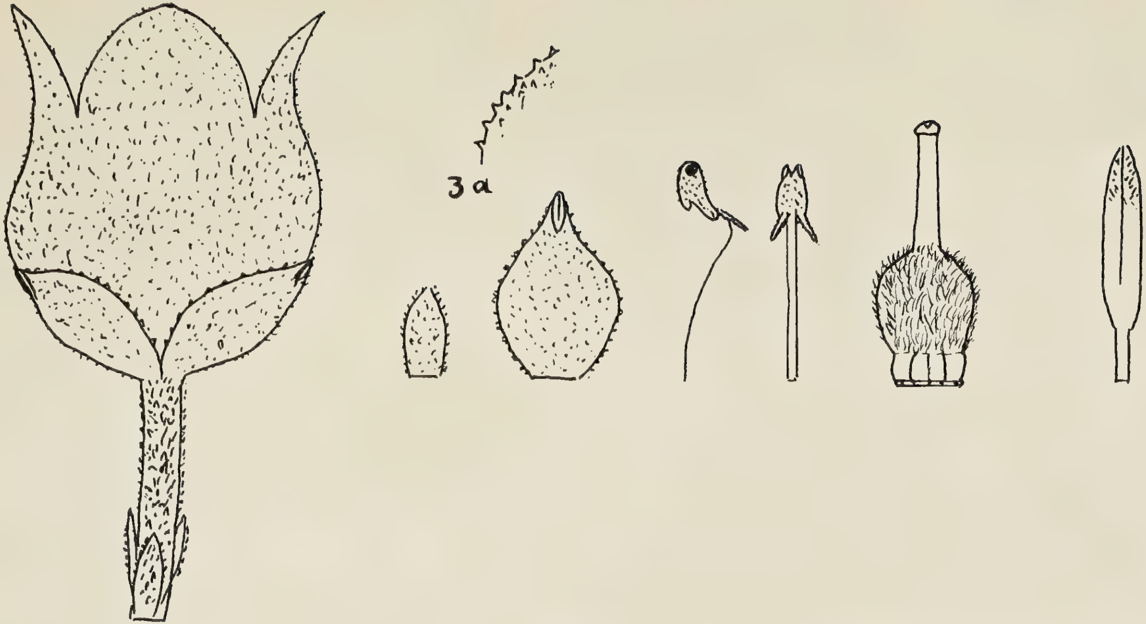

Fig. 6

Erica purgatoriensis H. A. Baker. *Baker* 2374. 1. flower; 2. bract; 3. sepal; 3a. edge of sepal enlarged; 4. anther, side view; 5. anther back view; 6. gynoecium; 7. leaf, back. All × 10. *Del.* H. A. Baker.

hispid and setose-ciliate. 1·5 mm. long. *Corolla* broad-urceolate slightly narrowed at the throat, minutely hispidulous, dry, pink, 3·0 mm. long × 2·5 mm. wide; lobes slightly spreading, obtuse, 1·0 mm. long. *Anthers* included, more or less oblong, curves, bilobed and cuneate below, scabrid, appendiculate, 0·5 mm. long × 0·25 mm. wide; pore small. *Awns* spreading, setose, about two-thirds as long as the cell. *Filaments* affixed near the base of the cell, narrow and slightly sigmoid at the top. *Ovary* 4-celled, 16-ovuled, cylindrical on a short disc and somewhat wider and hirsute above. *Style* included, stout; stigma capitellate, small.

At the bottom of Franschhoek Pass the road runs between the extensive marshes of the Du Toit's River on the east side and the lower slopes of the mountain on the west. On the latter side are a series of small marshes on a slight slope and somewhat different in type to the marsh on the other side since the former probably dry out in summer. *E. purgatoriensis* grows in one of the small marshes about 50 yds. square in great profusion amongst dense vegetation and with its stems in the water. It is strange that it has not, apparently, been collected here before. The author hunted about on both sides of the road but found no more of this plant. In a very similar marsh only 80 yds. away grows *E. chrysocodon* in profusion but neither species was found in both marshes. The latter was found sparsely on the other side of the road where the ground falls away quickly to the perennial marshes and also, as one would expect, *E. curviflora*, yellow flowers, brown on the top. The latter was not represented above the road except for one plant with an all-yellow corolla and more advanced in its flowering period.

E. purgatoriensis has been collected in Viljoen's Pass by E. Ryder in Oct. 1931 and his collection is in the "incertae" in Bolus Herb. but, as is so often the case, there is no detail of the site on which it was collected. In a marsh at the lower end of the pass the author found a large and strikingly beautiful colony of *E. curviflora*, all-yellow corolla as above, but no *E. purgatoriensis*, only *E. parviflora*.

E. purgatoriensis cannot be said to be closely related to any other species in the "Flora Capensis" or since described. It has been placed in *Ephebus* owing to its hairyness but it could, on account of its diffuse habit, be equally well in *Ceramia*. These two sections, as noted by the authors, are to some extent overlapping.

The author made an extensive search of the "incertae" in the Bolus and Compton Herbaria but no other collections were found. There are, however, several collections from the Hottentots Holland mountains of a species closely allied to *E. purgatoriensis*, but differing in several important respects, viz.: (1) anthers longer and of a quite different shape yet similarly awned; (2) stigma manifest at the mouth of the corolla and very large cyathiform; (3) the ovary is not on a glabrous disc; (4) the amount and quality of hairyness varies in these specimens but is, in general, of the same type. These collectings undoubtedly constitute a separate species. The following are the recordings noted: Esterhuizen 9150 Oct. 1943 Langkloofberge, in which the leaves are much hairyer, her 9173 from The Triplets, S.E. slopes 4–5,000 ft. In this the leaves are deeply sulcate to narrowly open-backed, and by Stokoe 6641, 6645 from Landrostkop and Nieuwberge, 8927 from between Sneeukop and Landrostkop, 4026 from Somerset Sneeukop (1934), 6641 from the same area in 1938. It will be noted that all the above come from the higher mountains. They are not noted as being collected in marsh but the conditions on the S.E. slopes high up may be somewhat akin.

Erica bolusiae Salter var. **cyathiformis** H. A. Baker var. nov. (*Ericaceae—Ericoideae*) Ephebus.

A forma typica ita differt: *Rami* juniores villosi. *Folia* petiolis inclusis 5—5·5 mm. longa, crinibus densioribus et longioribus, juniora erecta imbricata, vetustiora patula, semper quam internodia longiora. *Inflorescentiae* umbellatae, 2—8-flowered. *Corolla* cyathiformis.

A variety of the type differing as follows: *Branches* villous above; *leaves* 5—5·5 mm. long including the petioles, more or less upright and imbricate when young, later spreading horizontally, always longer than the internodes: *Inflorescences* in small umbels at the ends of the branchlets, 2—8-flowered. *Corolla* cyathiform.

Cape Province: Bellville District about 3 miles from Kraaifontein on the Durbanville road in sandy, flat soil. *Baker* 2280, *holotype* in Bolus Herbarium, March 1964.

A few strong and tall (up to 4 ft.) plants of this variety were found growing together with the typical form in a small clearing of a derelict wood among dead wood lying on the ground. The plants of the type were also very tall. If the two forms had not been found together it would have been reasonable to assume that the var. is but a shade form. A lot of specimens of the type were also collected in the open nearby and these conformed to the description in every way, including height, except that many inflorescences were umbellate as in the var. and as in *E. subdivaricata* which is a very near relative. Although the differences from the type are, perhaps, small the var. is immediately recognized because it looks different mainly on account of the set of the leaves and the extra hairyness.

I am indebted to Mr. Ion Williams for sending me the typical material which led to my going to the site with Mrs. Hill, wife of the owner of the farm, and discovering this variety.

Erica colorans Andr. var. *β* **breviflora** H. A. Baker var. nov. (*Ericaceae—Ericoideae*) Evanthe.

A forma typica ita differt: *Rami* non hirsuti et solum in junioribus puberuli. *Folia* linearia, foliis *E. tenellae* Andr. similia. *Pendunculus* duplo longior, bracteis intermediis et non corollam imbricantibus. *Corolla* 7·5 mm. longa, fere dimidio in longitudine quam in forma typica, lobis concoloribus et sepalis apte cum corolla logioribus. *Antherae* in forma leviter dissimiles et non atrae; aristis obscure decurrentibus quam in forma typica.

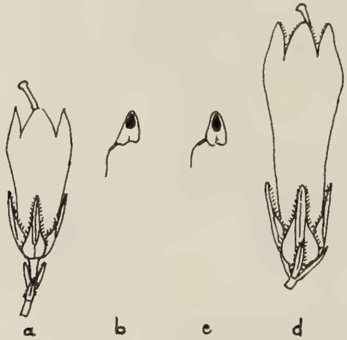

FIG. 7

Erica colorans Andr. *Var B breviflora* H. A. Baker *Baker* 1864. (*a*) Flower × 3; (b) Anther × 6;

Erica colorans Andr. *Baker* 1865. Flower × 3; (*c*) Anther × 6; *Del.* H. A. Baker.

Differs thus from the typical form: *Branches* not hirsute and only the younger puberulous. *Leaves* linear, similar to those of *E. tenella* Andr. *Peduncle* twice as long, with the bracts intermediate and not imbricating the corolla. *Corolla* 7·5 mm. long, about half the length of that of the typical form, with the concolorous lobes and sepals proportionately longer. *Anthers* slightly different in shape and not black, but with obscurely decurrent awns as in the typical form.

CAPE PROVINCE: Caledon Division. On the feature Paardeberg above Sandies Glen on the farm Fairfield, about 2,000 ft. (610 m.). *Baker* 1864, *holotype* in Bolus Herbarium.

This var. was found by E. G. H. Oliver and the author on 25th Oct. 1961 growing in a marsh at the head of a kloof. It was growing in profusion in association *inter alia* with *E. colorans* Andr. of the typical form and *E. tenella* Andr. but, whilst the variety was considerably past its flowering prime, the typical form was at its best. Fig. 2 shows the shape of the corolla and anther of each for comparison.

The corolla lobes of the typical form were shortly ciliate, which is unusual; in the var. this was not so. In neither were the corolla lobes coloured as depicted by Andrews though, in the author's experience, this is often the case and is not a good specific.

ACKNOWLEDGMENTS

The author is indebted to Capt. T. M. Salter for so kindly doing the Latin translations, to the Curators of the Bolus and Compton Herbaria for allowing him to use facilities at their disposal and to Mr. John Rourke for assistance in many ways.

A NEW SPECIES OF ALOE FROM TROPICAL ARABIA

J. J. Lavranos

(With Plates XXVI & XXVII)

Aloe doei Lavranos. Nova species, affinis *A. niebuhrianae* Lavranos, sed habitu fere solitario, pedunculo graciliore, perianthio stricto, angustiore, ubique sparse sed longissime piloso, segmentibus exterioribus perianthii solum per 10—14 mm. liberis differt.

Planta fere solitaria, breviter caulescens; *folia* 12—14, junioria adscendentia, deinde patentia, apice paulo recurva, 30—35 cm. longa, basi 8—10 cm. lata, *supra* viridula, interdum sparse albo-maculata, planiuscula vel leviter concava, *subtus* convexa; foliorum *margines* sinuati, dentibus pungentibus, deltoideis,

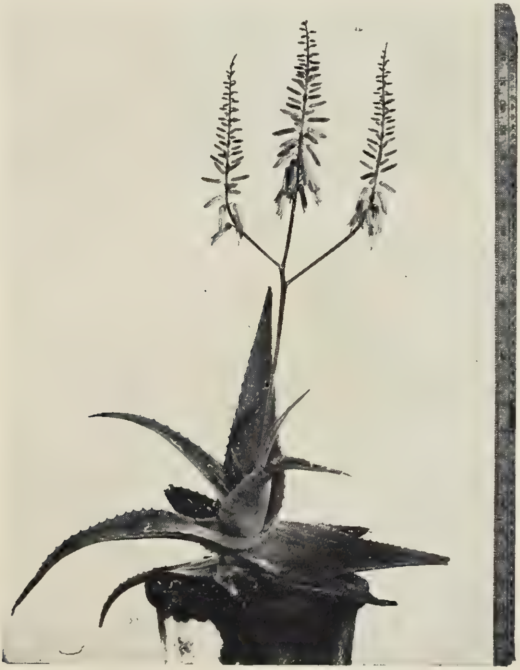

Plate XXVI

A. doei Lavranos
Plant from the Audhali Escarpment flowering in cultivation.
Photo: Botanical Research Institute, Pretoria.

a 3 mm. longis, 8—12 mm. inter se distantibus armati; *inflorescentiae* 2-vel 3-ramosae, a 70 cm. altae, ramis arcuato-erectis; *pedunculus* basi plano-convexus, 10 mm. latus, deinde teres; *racemi* conici, 15—20 cm. longi, 5 cm. lati, subdensi; *bracteae* deltoideae, 3—6 mm. longae, 2—3 mm. latae; *pedicelli* virides, 5—7 mm. longi, glabri; *perianthia* flava, ca. 25 mm. longa, fere stricta, supra ovarium 7 mm. diam., extus ubique sed sparse pilis a 8—9 mm. longis induta, segmentibus exterioribus per 10—14 mm. liberis, interioribus latioribus; *filamenta* basi albida et complanata, deinde filiformia et rubro-brunnea, *antheris* aetatae per 4 mm. exsertis; *stigma* demum per 5 mm. exsertum; *ovarium* laete viridium, 5 mm. longum, 2 mm. diam., apice truncatum.

Southern Arabia. Edge of Audhali Escarpment, 10 miles East of Ras Thira on the track leading to Marwaha, alt. ca. 7,400 ft. (2,250 m.), lat. 13° 59′ N., long. 45° 56′ E., coll. 17 Aug. 1962, fl. Bryanston Dec. 1964–Jan. 1965, Lavranos et Doe 2264, holotype (PRE).

Description

Plants usually solitary, occasionally forming small groups.

Leaves 12–14, the young ones ascending, the older ones spreading with slightly recurved apices, 30—35 cm. long, 8—10 cm. broad at base; *upper surface* dull green, sometimes bearing a sparse scattering of white, roundish spots, flat at base but slightly canaliculate towards the apex; *lower surface* broadly convex, unicoloured; *margins* markedly sinuous with a purplish-brown, cartilaginous border and armed with hard, sharp, red-brown, deltoid teeth which are up to 3 mm. long and 8—12 mm. distant;

Inflorescence 2- or 3-branched, to 70 cm. tall, the branches arcuate-erect.

Peduncle plano-convex at base and in its lower portion, terete thereafter, grayish-brown with a bloom, 10 mm. broad at base, 5 mm. diam. below the first branch, the branches produced from its upper third.

Racemes 15—20 cm. long, 5 cm. broad, conical, all buds spreading almost horizontally, open flowers, pendulous;

Bracts rather small, deltoid, whitish, 5- to 7-nerved, 3—6 mm. long, 2—3 mm. broad.

Pedicels green, glabrous, 5—7 mm. long.

Perianths yellow, cylindric-trigonous, covered rather sparsely with very long (up to 8—9 mm.) white hairs over the entire outer surface, 25—26 mm. long, 7 mm. diam. over the ovary, the mouth much compressed laterally; *outer segments* free for 10—14 mm., with three prominent bright green nerves which become confluent towards the slightly recurved apices; *inner segments* pale yellow, broader than the outer.

Filaments much flattened and whitish at base becoming filiform and red-brown in their upper part, the 3 inner narrower and lengthening before the 3 outer, the *anthers* dark brown on back and exserted in turn by 4 mm.

Style yellow, the *stigma* at length exserted by 5 mm.

Ovary bright green, 5 mm. long, 2 mm. diam., the apex truncate.

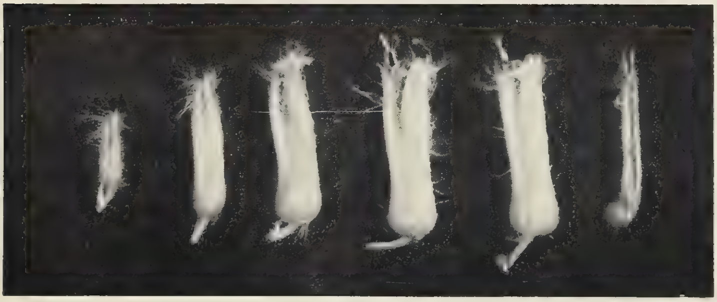

PLATE XXVI

A. doei Lavranos
Flowers 1/1 from bud to post-pollination stage.
Photo: Botanical Research Institute, Pretoria.

This new species was first found by Mr. Brian Doe, at present Director of Antiquities, Aden, in the magnificent country along the edge of the Audhali Escarpment, at ca. 7,400 ft., during an excursion which we made along the Marwaha track on a stormy afternoon in August, 1962, together with Major M. D. van Lessen and Mr. C. C. C. Meintjes. Plants were not numerous and almost all were solitary. None were in flower but a plant now in cultivation at Bryanston, near Johannesburg, flowered in late Dec. 1964 and early Jan. 1965, when the present description was drawn up.

A. doei is nearest allied to *A. niebuhriana* Lavranos which occurs in large numbers at about 500—1,500 ft. near Tor al Baha in the hot, arid foothills of the Subaihi country of S. Arabia. *A. niebuhriana* differs, however, in forming large, dense groups, and in having more robust, usually simple inflorescences, larger bracts, longer, somewhat curved perianths which are usually pubescent or, more rarely, hairy on the free part of the perianth-segments only. In *A. niebuhriana* the the outer perianth-segments are free for 19—21 mm., the pedicels and terminal portion of the inflorescence being usually pubescent. In *A. doei* the pedicels and the peduncle are glabrous.

A. doei is very closely related to certain plants which occur in considerable numbers at Moledera, south of Erigavo in Northern Somalia and have been attributed by Dr. G. W. Reynolds to *A. tomentosa* Deflers. However, this form, besides having leaves with short, blunt, rather distant marginal teeth, is distinguished by its pink, densely tomentose-shaggy perianths, the outer segments of which are free for only 9 mm. and which could not be confused with those of *A. doei* with their sparse covering of very long hairs.

I suspect that some of the plants collected in various localities along the Audali Escarpment and which I thought belonged to *A. doei* may, in fact, represent a different species, while certain plants collected in the higher parts of the Lodar plain may, in the end, prove to belong to the species described here.

This interesting species is named in honour of Mr. Brian Doe, in recognition of his active interest in Arabian Botany and of the encouragement which I have received from him over a long period.

Acknowledgments

I am grateful to:

The High Commissioner's Office, Aden and the Office of the Deputy High Commissioner, Al Ittihad, for permission to visit Aden and the interior.

The Federal Ministry of Agriculture, Aden, for providing transport, the use of their rest-houses in the Audhali country and much other help.

The O.C., Federal Regular Army, Aden and the Secretary and Members of the F.R.A. Officers' Mess for their hospitality.

Mr. Brian Doe, for his interest and help and for drawing my attention to the species here described. Mr. C. Meintjes, Mr. and Mrs. T. W. Hague, Mr. James Nash, Mr. and Mrs. J. Goldsworthy, Mr. P. Mulholland, and Miss S. Brodribb-Pughe for their contribution to the success of my two journeys to the Audhali country.

Dr. L. E. Codd, Chief, Botanical Research Institute, Pretoria, and his Staff, as well as Dr. R. A. Dyer, for their guidance in matters of Botany and for the photographs accompanying this text.

Dr. G. W. Reynolds for much help in connection with *Aloe*, for his encouragement and for his contribution towards the costs of my 1964 journey.

Dr. K. V. Mortimer, Messrs. Hoffmann La Roche, Inc., of New Jersey, Dr. A. Brossi, Mr. J. Marnier-Lapostolle, The New York Cactus and Succulent Society, Mr. J. M. Foulcher-Delbosc, Mr. G. Kalmbacher, Prof. I. Greenberg, The New Jersey Cactus and Succulent Society, Dr. J. P. Bruyns-Haylett, Messrs. Sana Pietersen Ltd. and the late L. du B. Barnard for assisting me to finance my two expeditions to Arabia.

A NEW ALOE VARIETY FROM MALAWI

G. W. Reynolds

(With Plate XXVIII)

Aloe cameronii Hemsl. var. **dedzana** Reynolds. Var. nov., a forma typica racemis multo elongatis 20—25 cm. longis, 5 cm. latis, angustioribus, facile distinguitur.

Malawi (*Central Province*). Ex top of Dedza Mtn. racemes 20—25 cm. long, fl. 20 July 1942, H. B. Christian 459, holotype (SRGH), isotype (PRE); Rocky hill near Dedza, racemes 25 cm. long, 5 cm. broad, leaves 50 cm. long, 6 cm. broad, Christian 952 (SRGH); ex Dedza Mtn. cult. Nasonia, Cholo, 10 July 1952, Reynolds 6662 (PRE, K).

Southern Prov. 15 miles S of Monkey Bay, on Ft. Johnston road, cult. Greendale, 23 June 1958, racemes 20 cm. long, Leach 382 (SRGH).

Moçambique. *Sofala and Manica*, near Garuso (40 miles E of Umtali) cult. Greendale, fl. 21 July 1958, racemes 18 cm. long 5 cm. broad, L. C. Leach 415 (SRGH) appears to belong here.

A. cameronii Hemsl. is an extremely variable species over its wide range of distribution from Great Zimbabwe in Rhodesia in the south, to Northern Malawi. In some localities stems are short and rosettes are small; in other stems reach 1 m. at more high with old dried leaf remains persistent.

In the typical form racemes average 10—15 cm. long, 7—8 cm. broad, the inflorescence being mostly dichotomously 2—3-branched, while in the dry winter months the rosettes of leaves often turn a bright copper-red.

The var. *dedzana* is very distinctive and differs from the typical form in having narrow *racemes* that are 20—25 cm. long and only 5 cm. broad. *Plants* form dense shrubs with stems 50—80 cm. long, the apical half being subdensely foliate. *Leaves* average 50 cm. long, 6 cm. broad, and turn an attractive somewhat shiny copper-red in winter.

Inflorescence is 1—2-branched, about 60 cm. high. *Bracts* very small. *Pedicels* average 5 mm. long. *Perianth* is narrowly cylindric-curved, averaging 40 mm. long.

It seems that the late Mr. Basil Christian was the first to discover this striking variety on Dedza Mountain, Central Prov., Malawi, when he visited there in August 1938. Along the top of Dedza Mtn. appears to be the headquarters of this variety. It has also been collected by Mr. L. C. Leach 15 miles south of Monkey Bay, north of Fort Johnston, in the Southern Province of Malawi.

Large numbers of the var. *dedzana* are in cultivation at Ewanrigg near Salisbury, and put up a dazzling display in July.

ACKNOWLEDGMENTS

I am indebted to the S.A. Council for Scientific and Industrial Research for travelling grants that have enabled me to investigate the Aloes in Malawi and elsewhere in Africa.

The Chief, Botanical Research Institute Pretoria, for photographs, and for the facilities of the National Herbarium, Pretoria.

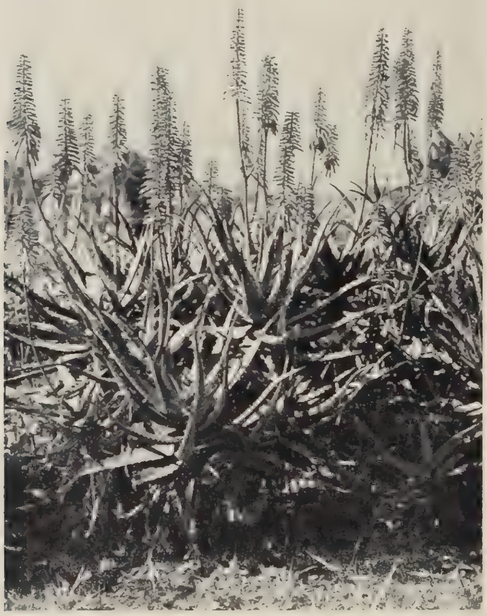

Fig. 1.

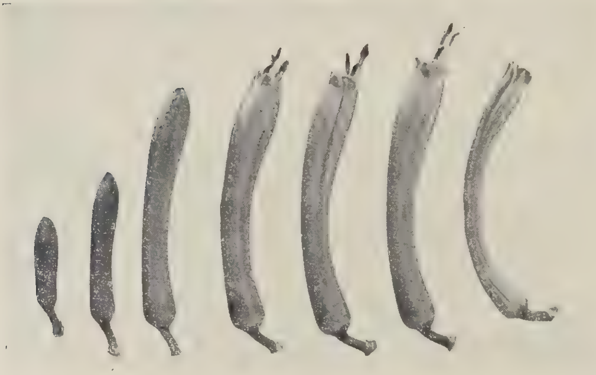

Fig. 2.

Plate XXVIII *Aloecameronii* Hemsl. var. *dedzana* Reynolds.

Fig. 1. Plants from Dedza Mountain, Central Malawi, grown at Nasonia, Cholo. Height 1·5 m.

Fig. 2. Flowers 1/1 from bud to post-pollination stage.

NOTES ON MESEMBRYANTHEMUM AND ALLIED GENERA

H. M. L. BOLUS

Amphibolia L. Bol. gen. nov.—Perennes; valvae capsulae alatae ut in **Lamprantho** et etiam loculi tuberculo onusti ut in **Ruschia** itaque **Stoeberiam** simulantes, sed ab ea capsula non sua sponte expansa et iterum claudente differt.*

The name is derived from the secondary meaning of the Greek *amphibolia*, "uncertainty or doubt", the primary one being "the state of being attacked on both sides."

Amphibolia maritima L. Bol. sp. nov.—Glabra; rami plures visi, diffusi, ad 18 cm. longi, internodiis 1·5—3 cm. longis, ad 3 mm. diam.; ramuli ultimi floriferi 2—6-foliati; folia ascendentia, mox late patentia, supra visa plana, prope apicem leviter angustata, acuta vel subobtusa, lat. visa superne saepius ± ampliata, apice rotundo, basi subdecurrente, lateribus convexulis, carina ad lineam reducta, subglauce viridia, juniora rubre tincta, 1—2 cm. longa cum vagina ca. 1 mm. longa, medio 6—8 mm. lato, superne ad 9 mm. diam.; flores diurni solitarii; pedunculi ad 6 mm., fructiferi 7—14 mm., longi; receptaculum subclavatum, ad 3 mm. longum, ad 4 mm. diam.; sepala 5, obtusa, 4—5 mm. longa, basi 2—4 mm. lata; petala 2-seriata, inferne leviter angustata, obtusa, pallide rosea, 5—6 mm. longa, ad 1 mm. lata; staminodia ad stamina conice conferta valde appressa eaque leviter excedentia, obtusa vel subacuta, pallide rosea, apice recurvo, massa parum infra medium constricta; filamenta ca. 4-seriata, intimis supra medium papillatis, antheris pollineque primum pallide luteis; discus crenulatus; ovarii lobi vix compressi, politi, leviter elevati; stigmata 5, anguste subulata, atre purpurea, intus papillata, externe brevissime hirsuta (in *Mesembrieis* non antea notata); capsulae 21 visae, infra clavatae 8-costatae, 5—9 mm. longae, 6—8 mm., expansae ad 15 mm., diam., supra 2—3 mm. elevatae, suturis leviter compressis, valvis expansis late patentibus, sat ample alatis, carinis inferne paralellis, superne divergentibus, prope apicem incurvatis, apicem valvae attingentibus, alis tegentibus ca. dimidium loculi attingentibus, tuberculo profunde posito; semina rotunda obovata, polita brunnea, ad 1 mm. longa.

Cape Province: in dit. Vanrhynsdorp; Strandfontein, prope Vredendal, Jan. 1965, *H. Hall* 2885. N.B.G. 4/65.

"On cliff down to high tide mark, in sandy soil, sprawling up to 6 ft in diameter." (*H. Hall.*)

Amphibolia hallii (L. Bol.) L. Bol. comb. nov.—*Stoeberia hallii* L. Bol.

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*Vide vol. 29: 176-177.

Amphibolia littlewoodii (L. Bol.) L. Bol. comb. nov.—*Stoeberia littlewoodii* L. Bol.

Conophytum litorale L. Bol. sp. nov. (*Euconophytum-Carruicola—Tuberculata*).—Vagina persistens anni prioris inferne tenuiter pergamentacea, pallide brunnea, superne crassior rugosa, grisea vel atro grisea; corpuscula obovata vel subpiriformia vel ovalia, 10—11 mm. longa, apice convexulo, rotundo vel ovale, 6—8 mm. diam., punctis sat paucis, sparsis vel 4—5 ± approximatis, lineam strictam vel curvatam utrimque ex ore ad marginem formantibus et os cingentibus, ore glabro, ad 4 mm. longo; pedunculus 4—6 mm. longus, basi bracteatus, bracteis obtusis vel subacutis, 1·5—3 mm. longis, vagina lobis parum breviore, sinu angusto; receptaculum 1·5 mm. longum, ad 2 mm. diam.; calyx ad 6 mm. longus, tubo 4—5 mm. longo, herbaceo roseo, in siccis superne cum segmentis conspicue rubre brunneo glandulifero, segmentis 5, obtusis, saepius 1·5—2 mm. longis, 0·5—1 mm. latis; corolla 11 mm. longa, tubo albido, 6 mm. longo, segmentis ca. 20, 2—3-seriatis, saepius obtusis, pallidissime roseis, saepius 0·25 mm. latis, inter angustissima visis; stamina 3—5-seriata, infima parum supra medium tubi adnata apicemque attingentia, cetera bene exserta, filamentis albis, antheris pollineque pallide luteis; discus profunde divisus, e ca. segmentis 10, fere integris, compositus; ovarium circa marginem profunde concavum, in medio brevissime conice elevatum, altitudinem basis disci non attingens; stylus vix 1 mm. longus; stigmata 5, 2 mm. longa.

Cape Province: in dit. Clanwilliam; "Papendorp, mouth of the Oliphant's River," *H. Hall*. N.B.G. 605/57. Fl. hort. L. J. Hill, Mart. 1959.

Conophytum admiraalii L. Bol. sp. nov.—Plantae 3 visae, ferae, ad 4·2 cm. altae, ad 4 cm. diam., e ramis primariis 2, vaginis persistentibus imbricatis brunneis vestitis, 2·8—3 cm. longis, compositae; ramuli ultimi 1·5—2 cm. longi; vagina persistens anni prioris inferne tenuiter pergamentacea, pallide brunnea, superne subpapyracea, pubescens, grisea vel atrate grisea; corpuscula elongate piriformia, pubescentia, olivaceo viridia, apice saepius late elliptico, convexulo, interdum ab ore ad marginem obscure carinato, parce saturatiore punctato, ore leviter ringente, dense pubescente, pilis patentibus, 2 mm. longo, ad 1·4 cm. longa, 5—7 mm. diam.; flores 2 visi; pedunculi 3—5 mm. longi, basi bracteati, bracteis obtusis, vagina lobis longiore, sinu angustissimo; receptaculum 1 mm. longum, 1·5 mm. diam.; calyx non bene visus, fugax membranaceus, ca. 3 mm. longus, segmentis 4, obtusis, ca. 1 mm. longis; corolla in siccis albida (in vivis color non notatus), 1·2—1·5 cm. longa, tubo 5—8 mm. longo, segmentis ca. 3-seriatis, obtusis, ad 1 mm. latis; stamina ca. 4-seriata, superiora bene exserta, filamentis aurantiacis, antheris pollineque pallide luteis; stylus 8—9 mm. longus; stigmata 4, ad 3 mm. longa; capsula 1 visa, infra breviter globose obconica, 2 mm. longa, 3 mm., expansa 6 mm., diam., supra obtuse 4-angulata, margine pallide brunneo, convexulo, deinde leviter depressa, medio vero leviter elevato, pedunculo gracillimo, 3 mm. longo; semina brunnea minutissima.

Cape Province: Namaqualand; "31 miles from the main road (Port Nolloth —Steinkopf) along the Kliphooghte road," Maio 1964, *J. Admiraal.* (*P. A. B. van Breda* 2073/64).

Conophytum archeri Lavis var. **stayneri** L. Bol. var. nov.—Plantae 3 visae, glabrae, sine floribus 2 cm. altae; vagina anni prioris inferne papyracea, superne subindurata, atre brunnea vel interdum grisea; corpuscula piriformia vel elongate piriformia, viridia vel lateribus purpureis, 1—1·4 cm. longa, basi ad 2 mm. diam., apice saepius elliptico vel late elliptico, convexulo, 5—7 mm. lato, 6—8 mm. diam., punctis saturatioribus, sparsis vel 2—5 approximatis, lineam obliquam vel curvatam formantibus osque parce cingentibus, ore leviter ringente, minute papillate pubescente, 1·5—3 mm. longo; flores nocturni; pedunculi 5—7 mm. longi, bene supra basim bracteati, bracteis ad 3 mm. longis, acutis, vagina lobis breviore, carina papillis rotundis (in siccis rubris) ornata; calyx demum exsertus, subcarnosus, superne rubidus, ad 6 mm. longus (in flore maturo marcescens breviorque), tubo ad 3·5 mm. longo, segmentis 4, obtusis, 2—2·5 mm. longis; corolla alba, ad 1·7 cm., saepius 1·1—1·3 cm., longa, tubo 4—6 mm. longo, segmentis ca. 4-seriatis, obtusis vel acutis vel acuminatis, ad 0·5 mm. latis; stamina 3-seriata, 16—20, demum omnia ± exserta, infima parum infra medium tubi adnata, filamentis albis, antheris pollineque primum pallide stramineis; discus conspicuus, segmentis fere integris; ovarium conice elevatum, altitudinem disci fere attingens; stylus albus, 0·75 mm. longus; stigmata 4, alba, 2·5 mm. longa.

A forma typica apice corpusculi non translucente, corolla alba (non vinacea), staminibus magis numerosis, stigmatibus longioribus, praecipue differt.

Cape Province: in dit. Montagu; Petrusfontein, "14 miles N.E. of Montagu," Nov. 1959, *F. J. Stayner*. Fl. Apr.—Maium 1960. Karoo Garden 823/59.

Drosanthemum diversifolium L. Bol. forma.—Plantae 3 visae, erectae glabrae, saepius laxe ramosae, 11—23 cm. altae, ca. ad 30 cm. diam.; caulis ad 9 mm. diam.; rami primarii ad 6 mm. diam.; ramuli graciles, apud basim saepius reliquiis membranaceis onusti, rubre brunnei, internodiis 1—3 cm., vel rarius ad 5 cm., longis, 1·5—2 mm. diam., ultimi floriferi 2—6-foliati, 2—7 cm. longi; partes herbaceae inconspicue papillosae, papillis rotundis; paria foliorum rarissime difformia; folia saepissime mox late patentia, interdum subfalcata, supra visa prope apicem leviter angustata, acuta, dorso demum rotundato, lat. visa non, vel leviter, angustata, obtusa, 1—2·2 cm. longa, medio 3—5 mm. lata diametroque, vel rarissime 1·5 cm. longa, 7 mm. diam.;

flores solitarii, per diem noctemque expansi, ad 4 cm. diam.; pedunculi in receptaculum insensim transeuntes, 6—10 mm., fructiferi 15 mm., longi; receptaculum subclavatum, ad 5 mm. longum, ad 6 mm. diam.; sepala 6, extima 2 variabilia, nunc oblonga, 6 mm. longa, nunc subobovata, 9 mm. longa, 5 mm. diam., nunc foliacea, ad 1·2 cm. longa, interiora superne obtuse subulata, late marginata, 3—4 mm., vel 5—6 mm., longa; petala ca. 3—4-seriata, exteriora e prope medium inferne angustata, obtusa vel subtruncata, primum pallide rosea, deinde alba, marcescentia rosea, ad 18 mm., saepius 10—15 mm., longa, ad 2 mm. lata, interiora pauca; staminodia nulla; filamenta ca. 4-seriata, conferta diu erecta, alba, ad 6 mm. longa, intima parum supra basim papillata, antheris pollineque primum luteis; discus inconspicuus 5-angulatus, angulis rotundis, profunde divisus; lobi ovarii obtuse compressi, distantes, discum vix attingentes, ad 0·75 mm. elevati; stigmata 6, gracillima, superne attenuata, ad 5 mm. longa; capsula infra clavata, 6-costata, ad 5 mm. longa, supra per 1 mm. elevata, suturis valde compressis, ad 7 mm., expansa 1·2 cm., diam.

Cape Province: in dit. Vanrhynsdorp; Strandfontein, prope Vredendal, Nov. 1964, *H. Hall* 2875. N.B.G. 557/64. "This lovely species was plentiful in rock pockets scarcely 10 feet above high tide mark." (*H. Hall.*)

Other collections of this form represented in the Bolus Herbarium, flowering in August and September, were made between Nardouw and Pakhuis, Doorn River Bridge and between Vanrhynsdorp and Bitterfontein. The type-material was not sufficiently adequate for a fuller description of this species.

Lampranthus maximiliani (Schltr. et Bgr.) L. Bol. comb. nov.—*M. maximiliani* Schltr. et Bgr., Engl. Bot. Jahrb. 57: 633 (1922); *M. phillipsii* L. Bol., Ann. Bol. Herb. 4: 5 (1925); *M. binum* N. E. Br. var. *muticum* L. Bol., Fl. Pl S. Afr. 7: 263 (1927); *Braunsia maximiliani* Schwant., Gartenwelt 644 (1928); *Echinus maximiliani* N.E. Br., Kew Bull 2: 57 (1929). This species was recently amply collected on a plateau (altitude ca. 2,000 ft.) between Matzikamma and Giftberg, "on flat to sloping rock surfaces with shallow soil or surfaces ± mossy only," *E. Esterhuysen* 30750. The seeds proved to be quite smooth and polished, as they also do in other collections in the Bolus Herbarium.

Braunsia stayneri (L. Bol.) L. Bol. comb. nov.—*Echinus stayneri* L. Bol. vol. 30: 237 (1964)—The generic name *Echinus* was used by Lour in 1790 and *Echinus* L. Bol. is a homonym.

CORRECTIONS AND ADDITIONAL NOTES

Vol. 30: 76, line 24. For 6414 read 6441 and line 35 for genus read section.

Astridia hillii L. Bol., vol. 28: 301 (1962). The description of the side view of the leaves (an important character in this genus) was omitted in the type-description. They are oblong, slightly narrowed towards the apex, or semiovate.

Conophytum regale Lavis, Mesemb. II: 469 (1934). A collection of this species bearing fruit, hitherto undescribed, was made in June 1964 in the type-locality by Mr. P. van Heerde (Bolus Herbarium 27656), who discovered the species. The capsule is globosely obconic in the lower part, in the upper slightly concave in the outer half, in the very middle produced into a sharp point 3 mm. long, 6 mm., expanded 1·2 cm., in diameter, valves up to 2·5 mm. broad at the base, the lower half amply winged, the upper forming a slender wingless cauda 2 mm. long, which is recurved in the fully expanded capsule. The lobes of the body are less in diameter and more sharply acute than in the typical form, which may have been cultivated.

Conophytum advenum N.E. Br. in Gard. Chron. 78: 451 (1925).—This very distinct species was discovered by Miss M. R. Michell (Dr. Levyns) and sent to Kirstenbosch where it was registered as N.B.G. 991/18. A portion of this collection was sent to Kew in 1919, which did not flower. Nor is any number quoted in the type-description. No second collection has been recorded.

When it flowered at Kirstenbosch shortly after it was received, drawings and notes were made by Miss M. M. Page and some of the former were published in 1950 (Mesemb. III: plate 44 I). The following description is derived from her notes: "body 6 mm. long, dull grey green with purple dots confluent into lines, apex convex; receptacle 2 mm. long, 1·5 mm. diam.; calyx exserted papillose, 4 mm. long, segments 4, acute or obtuse 1 mm. long; corolla 7 mm. long, segments linear, copper-red externally, paler and more yellow on the inner side; stamens 2-seriate, pale yellow, up to 4 mm. long, anthers only of the upper series exserted; disk 1·5 mm. diam,; style and the 4 stigmas up to 1·5 mm. long, the stigmas a little longer than the style.—On the first evening the flower opened about 8 and was slightly scented."

The specific name is derived from *advena*, a stranger, the opposite of *indigena*.

C. leightoniae L. Bol. (Mesemb. III: 85 and plate 23 C.) which was included in **C. advenum** (Jacobs. Handbook III: 1047) may be distinguished by its more obtuse calyx-segments, pink corolla, 3-seriate stamens, the 2 upper series well exserted, the longer style and the longer pink stigmas.

Conophytum pisinnum (N.E. Br.) N.E. Br. in Gard. Chron. 71: 214 (1922).—The type of this species, collected by Dr. R. Marloth, was described without flowers and precise locality. A portion of the type sent from Kew to Kirstenbosch (N.B.G. 1086/27) flowered in April 1929, and a coloured plate was published in 1939 (Mesemb. III: plate 23 J). The collection made by Mr. P. A. B. van Breda (1829/63), "on decomposed slate in the Montagu Division, 25 miles from Montagu on the road to Karreevlakte," has been identified with this species and constitutes the second record.

Note.—The type-specimens of all new species described in this paper are in the Bolus Herbarium, University of Cape Town.

(To be continued)

BOOK REVIEW

Nature Adrift. By Dr. James Fraser. 178 pages with 5 colour plates and 75 black and white illustrations. G. T. Foulis & Co., London: 45s.

Nature Adrift is a work in which the author, Dr. James Fraser, has set out to entertain and instruct the more serious-minded layman. Dr. Fraser has chosen his title well because he deals with that part of marine life which is carried more or less passively in the ocean currents of the world—that is, the plankton. In these days of population explosions and the awareness of inadequate food supplies we often hear it said that Man must look to the sea to supplement what is produced on land. To such as think that plankton is the answer to the problem of feeding the world's starving millions Dr. Fraser points out, in his masterfully written last chapter, the futility of undertaking such harvesting with the techniques and equipment now at our disposal. This latter subject is however incidental to the primary one of the plankton itself. The intelligent reader is introduced to some of the fascinating organisms that constitute the plankton and their special niche in space.

Dr. Fraser is eminently suited to deal with this subject because he is a planktologist not only by profession but also, it seems, by compulsion. One is immediately impressed by the very excellent illustrations with which this book abounds. Dr. Fraser need make no apologies for having borrowed liberally from the work of others to provide these visual feasts; they are first class and his use of them shows his innate modesty and a high aesthetic sense.

The lay-out and general presentation of this work is of a high standard. Although I prefer a text on a matt paper I can appreciate that the layman, wishing to add this book to his library, might not. The necessity for the high quality paper is all the more obvious because of the large number of plates interleaved with the text. This arrangement of plates has resulted in a minimum amount of paging back and forth in order to refer to text and illustrations concurrently. The binding is good and it is possible to lay the book open on a flat surface at almost any page without the annoyance of having to hold the pages down.

It is always difficult for a scientist to know what to include in a work presented for the general public and to decide this is usually his most exacting task. His second is to present the contents in a readily digestible form without becoming irresponsible. In the first of these tasks Dr. Fraser has, I think, succeeded admirably—and in under 200 pages. He has chosen only what is essential to an understanding of the subject. In his second task I find the author has not been quite so successful, although, on the whole, he has discussed the various topics with assurance and clarity. At times I felt that a little more detail and a freer style would have added greatly to the general interest of the work. In this connection I feel that there are some serious omissions especially in the classification of the animals. There are, too, some factual inaccuracies, for instance, the name Chlorophyceae is not to be applied to all green plants, nor are green plants the only organisms that photosynthesise.

As a taxonomist, I should particularly like to commend the author for the skilful way in which he introduces and deals with the problem of orthographic errors and also the principle of nomenclatural priority. The latter topic is always a source of bewilderment to gardeners and the like, who imagine that taxonomists are bent upon causing chaos in the sphere of names.

Further I should like to say that I found the latter half of the book particularly interesting and informative. Although these chapters contain no facts which, in themselves, are either new or revolutionary, they are written in a novel and digestible form. In general I would say that the author has achieved what he set out to do and the book should find a wide reading public among those who wish to know and understand more about the world in which we live.

R. H. Simons.

C.T.P. LTD.

JOURNAL

OF

SOUTH AFRICAN BOTANY

VOLUME 31 · PART 3 JULY 1965

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NATIONAL BOTANIC GARDENS OF SOUTH AFRICA

Kirstenbosch, Newlands, Cape Province

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NATIONAL BOTANIC GARDENS OF SOUTH AFRICA

The National Botanic Gardens were established in 1913 by unanimous resolution of the Parliament of the Union of South Africa; Kirstenbosch, part of the Groote Schuur Estate at Cape Town bequeathed to the nation by Cecil Rhodes, being chosen as the site and reserved by the Union Government for this purpose.

The Upper Kirstenbosch Nature Reserve, Table Mountain, was placed under the same control in 1922 for the better protection of the native vegetation.

The Karoo Garden at Whitehill was established by private benefaction in 1921. A new site was given by the Worcester Municipality in 1945 and the work was transferred there in 1946.

The Harold Porter Botanic Reserve at Betty's Bay was bequeathed by the late Harold Nixon Porter and placed under the control of the National Botanic Gardens of South Africa in 1959.

The Darling Flora Reserve and the Cape Flats Flora Reserve were acquired by private donation in 1957.

The Gardens are controlled by a Board of Trustees appointed by the Government, the Botanical Society of South Africa, the Cape Provincial Administration, the Cape Town City Council, the South African Railways and the University of Cape Town. The Director is one of the Professors of Botany in the University of Cape Town and is appointed jointly by the University and the Trustees.

The funds of the Gardens are derived from (1) grants made by the Government, the S.A. Railways, the Cape Town Corporation, the Cape Provincial Council, the Cape Divisional Council, the University of Cape Town and the Worcester Municipality; (2) private benefactions, either direct or through the Botanical Society; (3) sales and miscellaneous.

The primary objects of the Gardens are scientific and educational; the collection, cultivation, study and display of the indigenous flora of South Africa; the preservation of the native vegetation of South Africa.

Kirstenbosch, the Karoo Garden, the Harold Porter Botanic Reserve, and the Darling Flora Reserve are open to the public during daylight every day of the year. The Cape Flats Flora Reserve may be visited with permission from the Director.

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The Society, founded in 1913, and now consisting of over 3,500 subscribing members in all parts of South Africa and in other countries, exists primarily to give general and financial support to the work of Kirstenbosch and Worcester. The whole of its annual income, after paying expenses, is granted to the Trustees of the Gardens for current expenditure; and the sums accumulating in its fund from the subscriptions of life members are also granted to the Trustees for special pieces of development. Members of the Botanical Society enjoy certain privileges which include participation in the scheme of free distribution of surplus seed from Kirstenbosch and the Karoo Garden.

The President of the Botanical Society is Mr. Dudley R. D'Ewes; the Vice-Presidents are Mr. C. J. Sibbett, Professor H. B. Rycroft and Professor R. H. Compton, and there is a council of fifteen.

The membership subscriptions are as follows: *Benefactors*, R1,000.00; *Patrons*, R200.00; *Life*, R50.00; *Corporate*, R10.00 p.a.; *Family*, R5.00 p.a.; *Ordinary*, R3.00 p.a. Additional subscriptions are payable voluntarily in support of the Wild Flowers Protection Section of the Society. The Secretary and Treasurer of the Botanical Society of South Africa, Kirstenbosch, Newlands, C.P., will supply full information and applications for enrolment should be addressed to her.

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JULY 1965

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JOURNAL OF SOUTH AFRICAN BOTANY

The Trustees of the National Botanic Gardens of South Africa have undertaken responsibility for the publication of the JOURNAL OF SOUTH AFRICAN BOTANY. This periodical publishes contributions embodying the results of botanical research in any of the various branches of the science. It provides a medium for the publication of work on the South African flora whether systematic, ecological, morphological or otherwise, and whether carried out in South Africa or in other countries; and also on botanical subjects of special interest and application in South Africa.

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A PRELIMINARY ACCOUNT OF THE NGOYE FOREST RESERVE, ZULULAND*

B. J. Huntley

(With Plates XXIX—XXXVII)

Abstract

The history, position and environmental factors of Ngoye Forest are described and its future discussed. The main plant communities and their inter-relationships are dealt with, special reference being made to the tropical affinities of both flora and fauna.

A simple management programme is recommended, whereby the Reserve would be conserved as a Scientific Research Area.

Introduction

In October, 1960, the author visited Ngoye Forest Reserve at the invitation of Messrs. I. F. Garland and K. H. Cooper. Since this date, several short visits and three fortnight-long collecting trips have been made.

This report is a summary of notes made on these visits.

The spelling given by Doke and Vilakazi (1953), i.e. "*Ngoye*, a range of hills and forest in Zululand", is correct. The use of all other spellings should be avoided. In this report Ngoye Forest Reserve is frequently referred to as "the Reserve".

Ngoye Forest Reserve is situated in south-east Zululand, at latitude 28° 50 'S, longitude 31° 42′ E (Fig. 1). The Reserve was proclaimed in terms of section five of Act No. 16 of 1913. The boundaries are demarcated in the field

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* Part of the cost of the publication of this article was borne by the Durban Branch (Coastal Zone) of the Wild Life Protection and Conservation Society of South Africa.

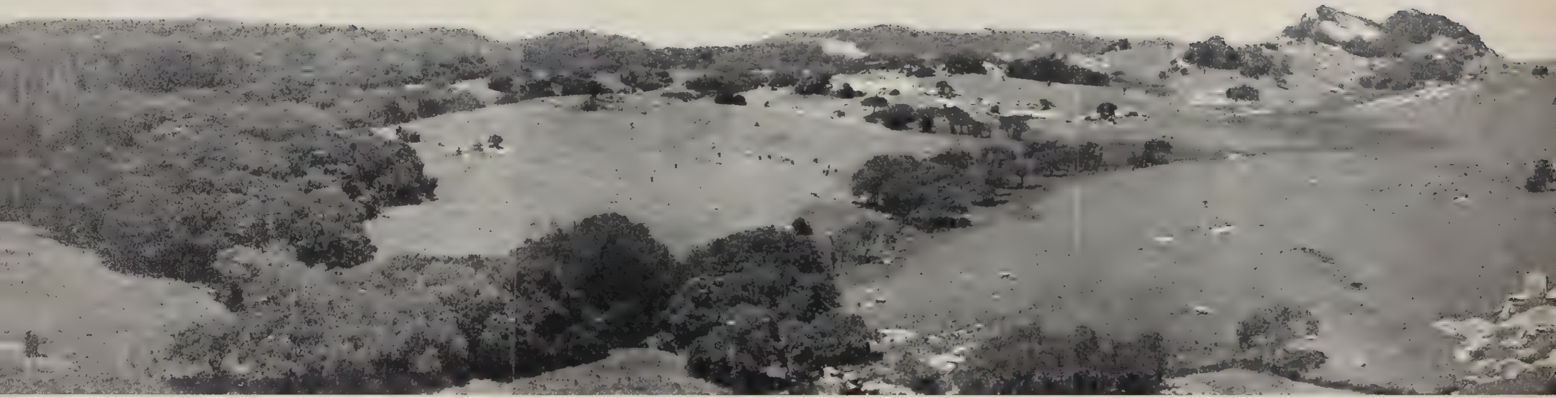

PLATE XXIX
Panoramic View of various Plant Communities from Kwa-ndodinuka.

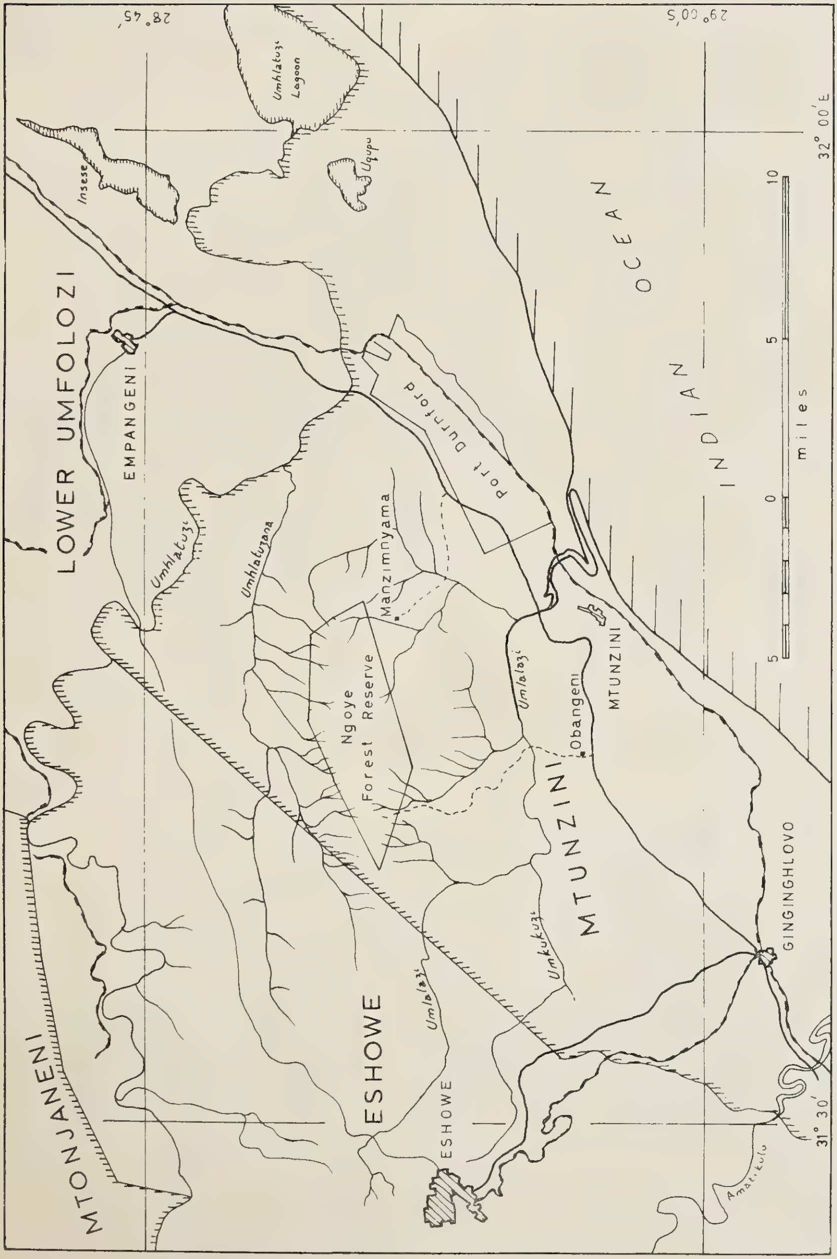

Fig. 1. Map of Mtunzini magisterial district showing position and drainage of Ngoye Forest Reserve.

by Forest Department Beacons 1 to 7. Native Reserve No. IX, proclaimed by the 3rd Interim Report of the Zululand Lands Delimitation Commission, 1903, surrounds the reserve.

The area is 9,648·6 acres of which approximately 7,000 acres is indigenous forest.

The Forest Guard camp at the Reserve may be approached by 4-wheel drive vehicles from Port Durnford Plantation by a very rough track, the trip of ten miles taking over an hour. The repair of an alternative route, following the old Ngoye Forest Company road via Manzimnyama School, is recommended.

The south-western extreme of the Reserve may be reached by 4-wheel drive vehicles via Obanjeni Store.

Physical Factors

Physiography

The Ngoye Range is described by McCarthy (1961) as an upfaulted horst of Basement Complex rocks bounded by the Umhlatuzi and Umlalazi Faults, to the north and south of which lie downfaulted Cape and Karoo system sediments.

The Basement Complex rocks at Ngoye comprise two main types, biotite granite gneiss and hornblend biotite schist; the former very resistant rock is overlain by the latter which is more easily weathered. Differential weathering of the two rocks has resulted in a sharply defined scarp at their southern confluence. Most of the forest is on the biotite granite gneiss at an altitude of 1,000 to 1,500 feet above sea level.

The range is drained by the Umhlatuzana River and its tributaries to the north and by the Umlalazi River and its tributaries to the south. Jointing of the biotite granite gneiss has resulted in a rectangular drainage pattern of the deeply incised forest streams.

Climate

Climatic data for the Reserve are not available, but the climate is almost identical with that of Eshowe, about 15 miles to the west, for which temperature and rainfall recordings are presented in Fig. 2.

The mean annual temperature is 19·6°C (67·08°F); an absolute maximum of 41·7°C (105·6°F) was recorded in 1941, and an absolute minimum of 2·3°C (36·14°F) in 1936.

The prevailing winds are from the north-east, associated with fine weather conditions; and from the south-west, which generally coincide with the passage of a low pressure trough and heavy rains. Wind damage to emergent forest trees is frequent, *Macaranga capensis* and *Millettia sutherlandii* being particularly susceptible. Despite the distance from the sea (approx. 7 miles), shearing

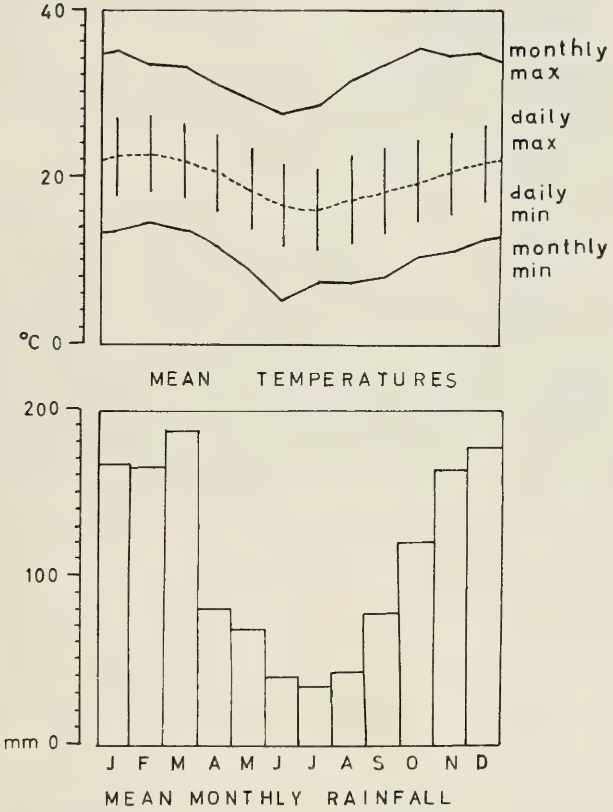

Fig. 2. Climatic data for Eshowe; lat. 28° 53′ S., long. 31° 28′ E. Alt. 530 m. Recording period 1921–1950.

of trees and shrubs by salt spray laden south-east winds is common on exposed sea facing slopes.

Rainfall distribution is distinctly seasonal; of the mean annual of 1,319 mm. (51·8 in.), 74% falls during the summer months of October to March. An absolute maximum of 2,335·5 mm. (91·5 in.) in 1925, and an absolute minimum of 763·8 mm. (30·0 in.) in 1931, have been recorded during the period 1921—1950.

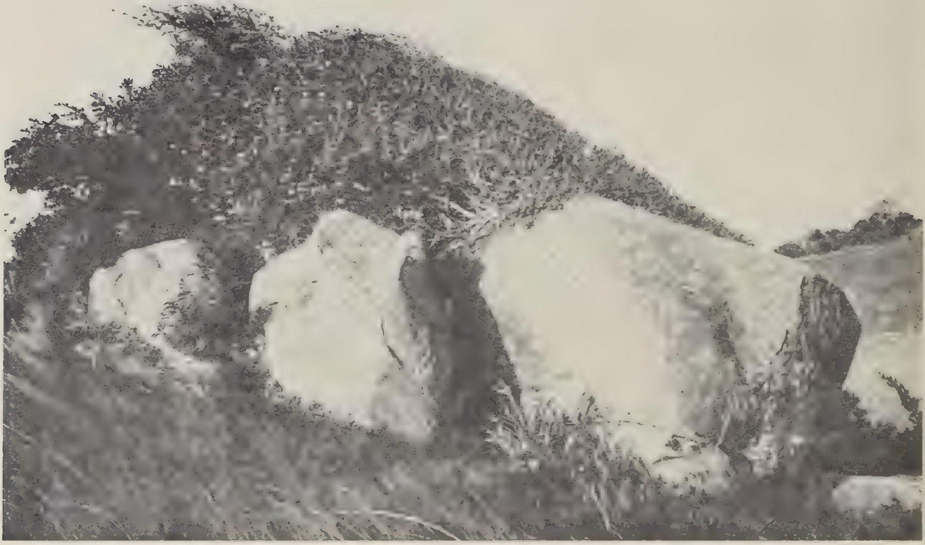

PLATE XXX
Wind-sheared *Ficus ingens* growing as chasmophyte on boulder outcrop. Prevailing wind south-east.

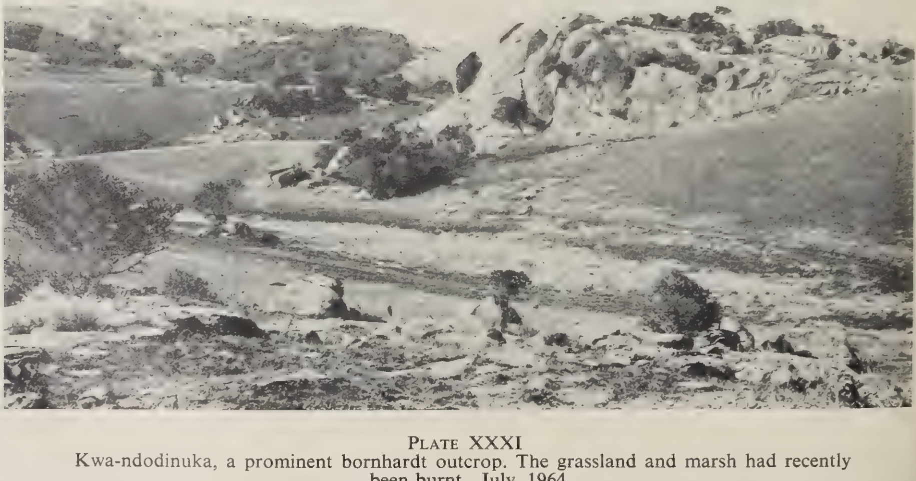

PLATE XXXI
Kwa-ndodinuka, a prominent bornhardt outcrop. The grassland and marsh had recently been burnt. July, 1964.

VEGETATION

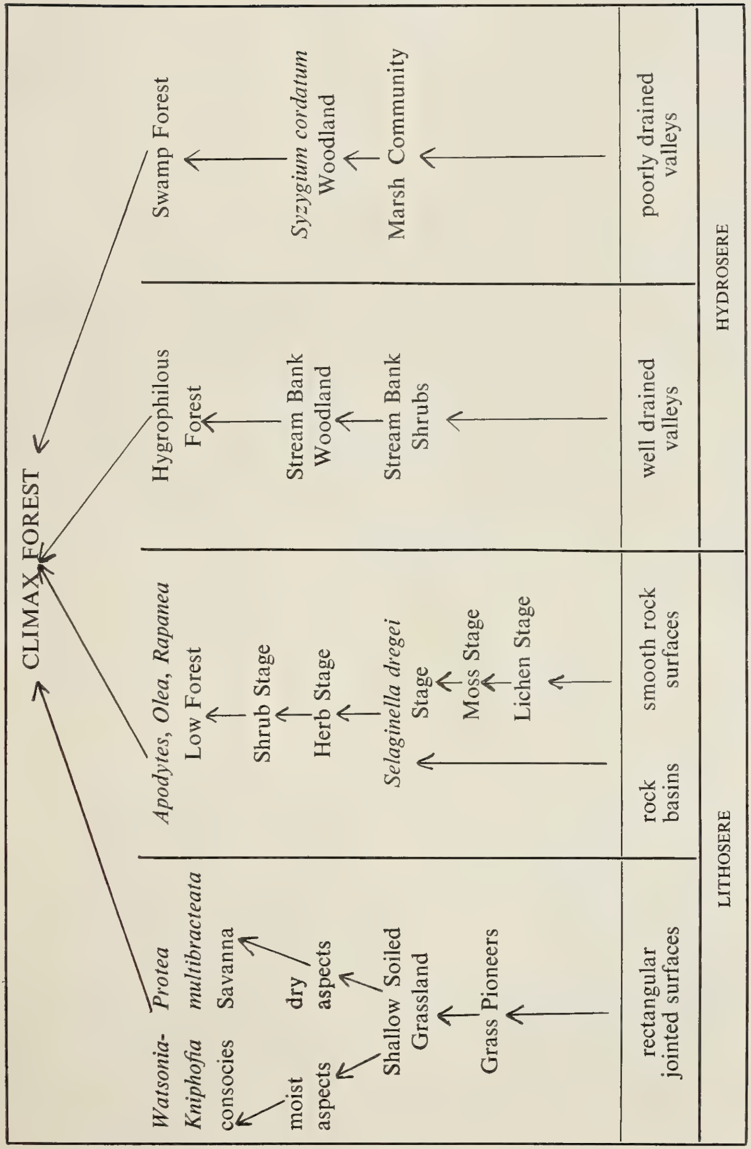

FIG. 3. Suggested interrelationships of main plant communities at Ngoye.

Notes on the plant communities are based in the main on qualitative observations, but several 20 ft. wide belt transects and three profile diagrams were compiled in order to obtain a quantitative assessment of various forest communities.

The species lists, unless otherwise stated, are compiled from material collected by the author in February and December 1963, and January and February 1964.

The suggested inter-relationships of the main seral communities are shown on Fig. 3.

Rock Outcrop Community

Plant succession on rock at Ngoye follows various courses depending on the character of the initial substrate. On smooth surfaces the following more important seral stages have been noted. The lichen stage is represented by crustose, foliose and fruticose lichens that occur as pioneers on smooth, bare rock surfaces. On the damper, cooler south-eastern slopes of the Khwezingqungqulu ridge this community is very well developed.

The moss stage is generally poorly developed, but on the mesocline of Swegogombe ridge mosses form fairly large mats.

The *Selaginella dregei* stage is well developed and forms dense mats which act as a substrate to the herbaceous stage. The mats contain rich invertebrate faunas. Baboons, ripping up the mats in search of food, cause extensive damage resulting in serious retardation of the succession. Where baboons have removed mats, the freshly exposed rock surface is pink in colour and very rough. It is possible that the acid soil water of the permanently moist pioneer colonies increases the chemical weathering of the biotite granite gneiss.

In some places weathering of biotite foliations and quartzofeldspathic veins has formed small rock basins. These basins are colonised by *Selaginella dregei*, without lichen and moss pioneers.

Key to Fig. 4:

Bm	Bridelia micrantha;
Bn	Bequaertiodendron natalensis;
C	Carissa wyliei;
Cd	Cyathea dregei;
Cf	Cassipourea gummiflua;
Cg	Cassipourea gerrardii;
Cm	Cryptocarya myrtifolia;
Cs	Cussonia spicata;
Cw	Cryptocarya wyliei;
Dg	Drypetes gerrardii;
Fc	Fagara capensis;
Fg	Flagellaria guineensis;
Gc	Grumilea capensis;
Gg	Garcinia gerrardii;
Hl	Halleria lucida;
Im	Ilex mitis;
Lp	Linociera peglerae;
Ml	Maesa lanceolata;
Mp	Microsorium punctatum;
Ms	Millettia sutherlandii;
Pd	Podocarpus latifolius;
Pr	Protorhus longifolius;
Pz	Plectranthus zuluensis;
Oa	Ochna arborea;
Rc	Rothmannia capensis;
Pa	Peddiea africana;
Sa	Scleria angusta;
Sc	Syzygium cordatum;
Sh	Strychnos henningsii;
To	Turraea obtusifolia;
Tv	Tabernaemontana ventricosa;
Vt	Voacanga thouarsii;

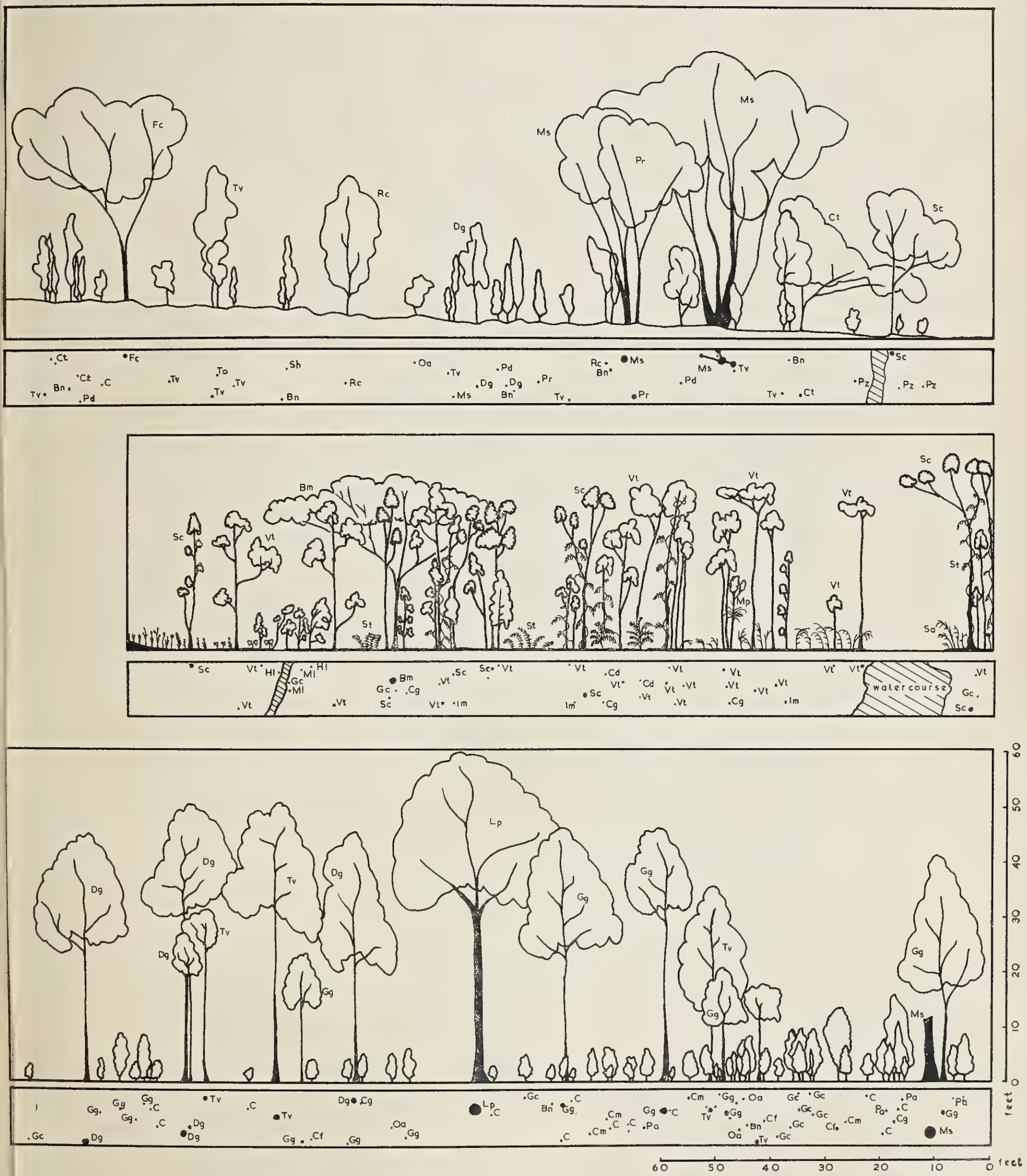

FIG. 4

Profile diagrams of: top, Forest Outlier Community; centre, Swamp Forest; bottom, Climax Forest. Each diagram represents a 10 ft. wide belt.

Early invaders of *Selaginella dregei* mats are short herbs up to 20 cm. tall, these including: the ferns *Asplenium rutaefolium*, *Pellaea calomelanos*, and *Phymatodes scolopendria;* the sedges *Bulbostylis contexta*, *B. humilis* and *Cyperus rupestris;* and the geophytes *Bulbine frutescens*, *Cyanotis nodiflora*, *Hypoxis filiformis* and *Scilla spp.* Taller herbs follow, including *Aeolanthus parvifolius*, *Cineraria atriplicifolia*, *Coleus sp.*, *Crassula ericoides*, *Helichrysum adenocarpum*, *Leontonyx tomentosa*, *Polygala rehmanni*, *Selago hyssopifolia*, *Senecio oxyodontus*, *Stachys grandifolia* and *Tritonia lineata*. Grasses include *Aristida junciformis*, *Eragrostis capensis*, *E. racemosa*, *Digitaria macroglossa*, and *Sporobolus africanus*.

The herbaceous stage is invaded by such shrub species as *Aloe arborescens*, *Anastrabe integerrima*, *Eugenia natalitia*, *Ficus ingens*, *Grumilea capensis*, *Hibiscus diversifolius*, *Maytenus acuminatus* and *Turraea obtusifolia*. Some of these species occur elsewhere as trees but on rock outcrops their growth is retarded by shallow soils.

With improving edaphic conditions, this shrub community, which attains a height of about 10 ft., gives way to a Low Forest Associes in which *Apodytes dimidiata*, *Olea capensis* and *Rapanea melanophloeos* are dominant.

This community has an uneven, discontinuous canopy, a well developed herbaceous field layer and many climbers. Trees range from 10 to 15 ft. in height, and include the dominants mentioned above and *Albizia adianthifolia*, *Cussonia spicata*, *C. umbellifera*, *Erythroxylum pictum*, *Harpephyllum caffrum*, *Millettia grandis*, *Mimusops obovata*, *Syzygium cordatum* and *Tarchonanthus camphoratus*.

The herb layer includes *Agapanthus patens*, *Clivia miniata*, *Kalanchoe sp.*, *Plectranthus sp.*, *Streptocarpus wendlandii* and *S. sp.*

Climbers include *Acridocarpus natalitius*, *Asparagus zuluensis*, *Buttonia natalensis*, *Dalbergia armata*, *D. obovata*, *Scutia myrtina*, and *Smilax kraussiana*.

The orchids *Cyrtorchis arcuata* and *Tridactyle bicaudata* are prolific in the deep humus of the margin to this associes.

A departure from the lithoseral succession as described above, occurs in areas where the rock is fissured. In certain areas the fissuring forms rectangular patterns. Grasses growing in these fissures include *Aristida junciformis*, *Cymbopogon validus*, *Hyparrhenia cymbaria*, *Rhynchelytrum setifolium*, *Schizachyrium semiberbe*, *Setaria sphacelata*, and *Sporobolus africanus*. Bare rock between the fissures is gradually covered over by humus and colonised by grasses and forbs.

In the damper areas of this grass community, associes of *Watsonia densiflora* and *Kniphofia gracilis* occur. In the drier areas, local *Protea multibracteata* Savanna may be present.

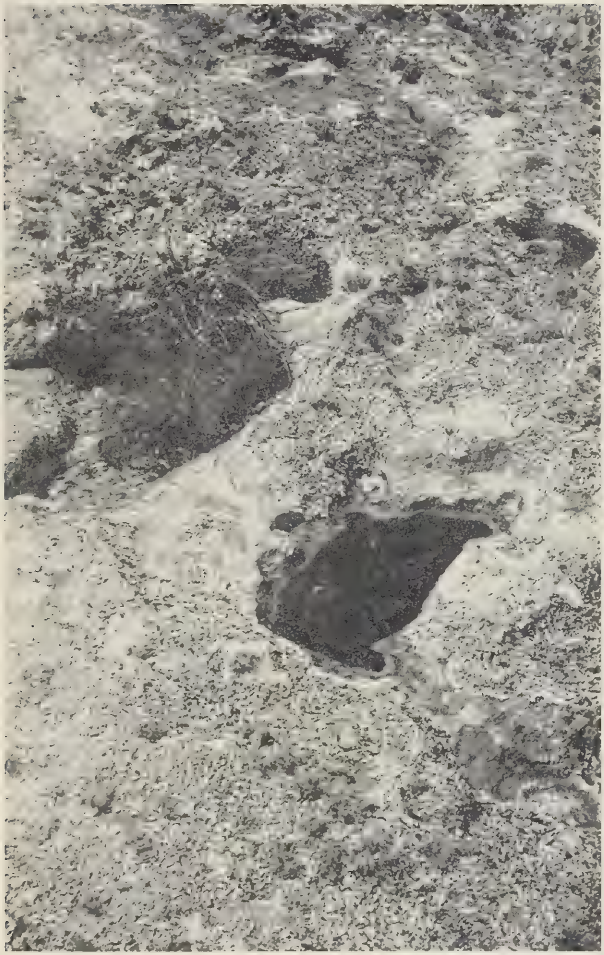

PLATE XXXII.

Crustose, foliose and fruticose lichens pioneering smooth rock surface. Note rock basins with accumulating soil and *Cyperus rupestris*. and *Hypoxis filifolius* colonizers. A small mat of *Selaginella dregei* may be seen to the right of *Hypoxis filifolius*.

Crevices on the bornhardt outcrops, filled with humus, are often directly colonised by trees and shrubs. *Ficus* species, including *F. burtt-davyii*, *F. capensis*, *F. ingens*, *F. polita*, *F. quibeba*, *F. soldanella* and *F. sonderi* are commonly found growing in this habitat. Other trees and shrubs occurring here include *Burchellia bubalina*, *Diospyros lucida*, *Eugenia natalitia*, *Grumilea capensis*, *Strelitzia nicolai* and *Tarchonanthus camphoratus*.

Grassland

The Reserve includes approximately 2,500 acres of grassland, approximately 1,200 acres of which covers the hills to the east of the Forest Guard camp, the remainder being spread in small patches around the forest perimeter. The floristic composition of the Grassland is mixed and in this respect differs markedly from the adjoining *Aristida junciformis* dominated Native Reserve.

The following species have been collected in the Reserve grassland: *Andropogon shirensis*, *Aristida junciformis*, *Digitaria macroglossa*, *Eragrostis capensis*, *E. racemosa*, *Hyparrhenia cymbaria*, *H. filipendula*, *Monocymbium ceresiiforme*, *Panicum dregeanum*, *P. natalensis*, *Paspalum commersonii*, *Schizachyrium semiberbe*, *Setaria sphacelata*, *Sporobolus africanus*, *Themeda triandra*, *Trachypogon plumosus* and *Tristachya hispida*.

The grassland forbs include: *Alepidea gracilis*, *Argyrolobium rupestre*, *Aristea gerrardii*, *Berkheya setifera*, *Cassia mimosoides*, *Cephalaria attenuata*, *Desmodium caffrum*, *D. hirtum*, *Dierama elatum*, *Eriosema cordatum*, *E. parviflorum*, *E. saligna*, *Habenaria dregeana*, *Helichrysum adscendens*, *H. appendiculatum*, *Indigofera eriocarpa*, *Lasiosiphon anthylloides*, *L. splendens*, *Lobelia erinus*, *Pentanisia angustifolia*, *Scabiosa columbaria*, *Scilla rigidifolius*, *Tephrosia canescens*, *T. glomeruliflora*, *T. macropoda*, *Thunbergia atriplicifolia*, *Wedelia menotriche*, *Xysmalobium undulatum*, *Zaluzianskya maritima* and *Zornia capensis*.

Root parasites include *Alectra orobanchoides*, *A. sessiliflora*, *Cycnium adonense* and *Striga bilabiata*.

Local socies of *Aristida junciformis*, *Encephalartos ngoyanus*, *Hyparrhenia filipendula*, *Kniphofia gracilis*, *Lasiosiphon splendens*, *Miscanthidium capensis*, *Stangeria eriopus* and *Watsonia densiflora* occur in the grassland.

Hydroseral Communities

The Ngoye Range is well drained by numerous fast flowing streams arising from valley-head springs. The major hydroseral communities studied may be discussed in two sections, (*a*) communities of the broader, poorly-drained valleys, and (*b*) vegetation lining the small fast flowing streams of the deeply incised valleys.

(*a*) *Poorly drained valleys*

The gentle slopes of the broader valleys are poorly drained and fairly extensive marsh communities occur. Sedges found here include *Cyperus immensus*, *C. isocladus*, *Fimbristylis complanata*, *F. dichotoma*, *Mariscus rivularis*, *Pycreus polystachyos*, *Rhynchospora sp.*, *Scirpus prolifer*, *Scleria angusta*, *S. melanomphala* and *Tetraria cuspidata*. Grasses include *Eulalia villosa*, *Ischaemum arcuatum* and *Setaria rigida*. Hygrophilous herbs are common and include *Buchnera dura*, *Eriocaulon sp.*, *Habenaria caffra*, *H. dregeana*, *Polygala capillaris*, *Sisyranthus imberbis*, *Thesium asterias*, *T. natalensis*, *Utricularia livida*, *U. prehensilis*, and *Xyris natalensis*.

Open *Syzygium cordatum* Woodland is present in some valleys. Associated trees include *Voacanga thouarsii* and *Rauwolffa caffra*. Shrubs occurring in this community include *Dissotis canescens*, *Stachys sp.*, and *Syncolostemon densiflorus*. *Aloe cooperi* and *Eulophia speciosa* occur in the more open parts.

The edaphic climax of the marsh hydrosere is the *Syzygium cordatum* and *Voacanga thouarsii* dominated Swamp Forest. The canopy at 25 to 35 ft. is dominated by *Syzygium cordatum* and *Voacanga thouarsii* with *Bridelia micrantha*, *Halleria lucida*, *Ilex mitis*, *Macaranga capensis* and *Tabernaemontana ventricosa* as associates.

Tall ferns of up to 7 ft. form a dense stratum comprising such species as *Cyathea dregei*, *Dryopteris gongylodes*, *Lonchitis pubescens* and *Stenochlaena tenuifolia*: The presence of *Cyathea dregei*, typically a heliophyte, in the Swamp Forest shrub layer, is of interest.

The tall sedge, *Scleria angusta* occurs in this stratum in which shrubs such as *Maesa lanceolata* and *Grumilea capensis* are found.

A herb layer is absent except on the margins of the Swamp Forest, where dense communities of *Plectranthus sp.* and *Zantedeschia sp.* may occur.

Climbers include the fern *Stenochlaena tenuifolia* and the armed woody climbers *Asparagus falcatus*, *Dalbergia armata* and *Entada spicata*.

Epiphytes are common, the orchids *Bulpophyllum sandersonii* and *Cyrtorchis arcuata* and the fern *Microsorium punctatum* have been noted.

An interesting ecological feature of this forest is the deep water-logged peat in which the plants grow. Physiognomic characters of the trees include the mats of ageotropic pneumatophores of *Voacanga thouarsii*, stilt roots of *Bridelia micrantha*, buttresses of *Macaranga capensis*, and knee roots of *Cassipourea gerrardii*.

(*b*) *Well drained valleys*

The deeper, better drained valleys have fast flowing streams which are lined with shrubs and trees forming an open, discontinuous Stream Bank Woodland. Shrubs include *Dissotis canescens*, *Gerrardina foliosa*, *Myrica conifera* and *Passerina sp.* Trees include *Bridelia micrantha*, *Erythroxylum pictum*, *Ficus* *capensis*, *Halleria lucida*, *Ilex mitis*, *Rauwolffa caffra*, *Syzygium cordatum* and the tree fern *Cyathea dregei.*

Stream Bank Woodland develops into Hygrophilous Forest in which *Croton sylvaticus* and *Macaranga capensis* dominate. Associated trees include those listed for the Stream Bank Woodland with *Rawsonia lucida* and *Oxyanthus gerrardii* in addition. The canopy of 30 ft. to 45 ft. is uneven and discontinuous. Shrubs in this forest include *Mackaya bella* and *Rothmannia globosa*, and suffrutices include *Justicia campylostemon*, *Piper capensis*, *Plectranthus zuluensis* and *Thunbergia natalensis.*

The banks of the larger streams lined with Hygrophilous Forest present a magnificent sight in summer when the many brightly coloured herbs are in flower. These include *Aneilema aequinoctiale*, *Begonia sp.*, *Clivia miniata*, *Commelina benghalensis*, *Crocosmia aurea*, *Dietes butcheriana*, *D. vegeta*, *Dracaena hookeriana*, *Haemanthus katherinae*, *Impatiens duthei*, *Streptocarpus wendlandii*, and *S. grandis.*

The orchid *Stenoglottis fimbriata*, the ferns *Microsorium punctatum* and *Vittaria isoetifolia* and the herb *Peperomia reflexa* occur as litho-or epiphytes.

Forest Margin

The seral communities from grassland to climax forest are very poorly developed on most of the 57 miles of forest margin.

Tall grasses of up to 7 ft. that occur on the forest margin include *Cymbopogon validus*, *Digitaria natalensis*, *Hyparrhenia cymbaria*, *Miscanthidium capensis*, *Setaria chevalieri* and *Sorghastrum rigidifolium.* Suffrutices and shrubs found here are *Arthrosolen calocephalus*, *Berkheya bipinnatifida*, *Crotolaria natalensis*, *Diospyros lucida*, *D. lycioides*, *Polygala virgata*, *Pseudarthria hookeri* and *Rhoicissus tridentata. Pteridium aquilinum*, the bracken fern, forms local consocies in damper areas of the forest margin.

Short trees up to 20 ft. occurring in the margin community include *Burchellia bubalina*, *Canthium mundtianum*, *Cassinopsis tinifolia*, *Dovyalis caffra*, *Garcinia livingstonii*, *Maesa lanceolata*, *Rhus fraseri*, *R. discolor*, *Vangueria infausta* and *Ximenia caffra.*

Trees of up to 50 ft. in height found on the forest margin include: *Albizia adianthifoïia*, *Bridelia micrantha*, *Croton sylvaticus*, *Cussonia spicata*, *C. umbellifera*, *Harpephyllum caffrum*, *Macaranga capensis*, *Protorhus longifolius*, *Rapanea melanophloeos*, *Rhus legati*, *Trema guineensis*, and *Vepris undulata.*

Numerous lianes make the forest margin almost impenetrable. Species recorded are: *Adenia gummifera*, *Asparagus falcatus*, *Dalbergia armata*, *D. obovata*, *Dioscorea dregeana*, *D. sylvatica*, *Flagellaria guineensis*, *Riocreuxia sp.*, *Rhoicissus rhomboidea*, *R. tomentosa*, *Sarcostemma viminale*, *Secamone frutescens*, *S. galpinii*, *Scutia myrtina*, *Smilax kraussiana*, *Strophanthus sp.*, and *Thunbergia dregeana.*

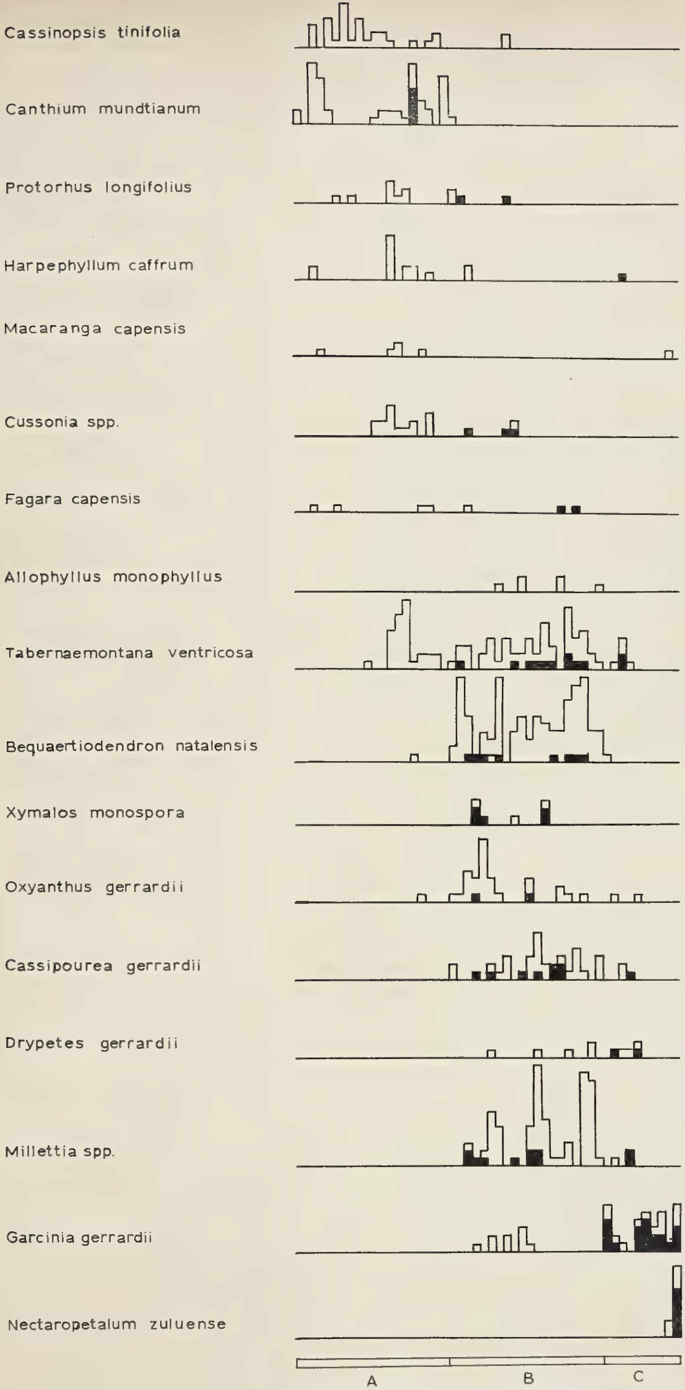

FIG. 5. Distribution of most frequent species recorded in 20 ft. wide belt transects through forest communities. Belt transect A (20 x 1,000 ft.) was through sample plots of *Cupressus lusitanicus*, *Eucalyptus saligna* and *Pinus patula*. Belt transect B, (20 x 1,000 ft.) through forest margin and secondary forest. Belt transect C (20 x 500 ft.) through Clunan Forest. Each block represents one stem recorded per 20 x 50 ft. section of the transects. Stems of more than 8 ins. diam. are indicated by shaded blocks.

The irregular canopy of the Forest Margin allows light to penetrate to the field and shrub layers which are consequently very dense. As shown in Figure 5, the stem diameters of Forest Margin trees are relatively smaller than those of the Climax Forest, but the density of stems and number of species occurring in the Forest Margin is far greater than in Climax Forest.

Climax Forest

Climax Forest is distinguished from forest margin and secondary forest communities by its continuous canopy, stratification with five recognisable strata, large size of trees, poorly developed shrub and field layers, paucity of lianes and abundance of epiphytes.

The tall trees rise above the general canopy, attaining 70 to 90 ft. Species include *Chrysophyllum viridifolium*, *Millettia sutherlandii* and *Podocarpus latifolius*. The emergent specimens of *Millettia sutherlandii* often have hollow boles and are susceptible to damage by strong winds, especially if they support a great weight of *Flagellaria guineensis*. Where trees of *Millettia* have been blown down, coppicing may occur, resulting in a multi-stemmed growth form. Damage to the surrounding forest caused by the death of old emergent trees results in local regeneration by light tolerant seedlings of forest margin species. This accounts for the appearance of such typically forest marginal species as *Albizia adianthifolia* as canopy trees deep within the Climax Forest.

The Upper Canopy stratum is continuous except where emergent species or fallen trees break through. It ranges from 45 to 65 ft. in height. The list of species included in this canopy is compiled from my observations supplemented by species recorded by Edwards and Wells (1961): *Antidesma venosum*, *Apodytes dimidiata*, *Brachylaena transvaalensis*, *Bridelia micrantha*, *Calodendrum capense*, *Casearia junodii*, *Celtis africana*, *Cryptocarya latifolia*, *Chrysophyllum viridifolium*, *Cussonia chartacea*, *C. umbellifera*, *Croton sylvaticus*, *Drypetes gerrardii*, *Ekebergia capensis*, *Fagara capensis*, *Ficus capensis*, *F. natalensis*, *F. petersii*, *F. polita*, *F. quibeba*, *Harpephyllum caffrum*, *Linociera peglerae*, *Macaranga capensis*, *Mimusops obovata*, *Nuxia floribunda*, *Olinia radiata*, *Podocarpus falcatus*, *P. latifolius*, *Protorhus longifolius*, *Pygeum africanum*, *Rapanea melanophloeos*, *Rauwolffa caffra*, *Scolopia mundtii*, *Scolopia zeyheri*, *Syzygium gerrardii*, *Strychnos henningsii*, *Trichilia emetica*, *Vepris undulata* and *Xymalos monospora*.

The subordinate tree stratum is from 15 to 45 ft. in height and may be divided into two classes, taller trees of 25 to 45 ft., and shorter trees of 15 to 25 ft. As my observations of this stratum are limited, the species list is again supplemented by the records of Edwards and Wells (1961).

Taller trees from 25 to 45 ft. include *Allophylus monophyllus*, *Bequaertiodendron natalensis*, *Cassipourea gerrardii*, *C. gummiflua var. verticillata*, *Cola natalensis*, *Garcinia gerrardii*, *Halleria lucida*, *Maytenus acuminatus*, *Ochna* *arborea*, *Nectaropetalum zuluense*, *Tabernaemontana ventricosa*, and *Trimeria rotundifolia*.

Shorter trees from 15 to 25 ft. include *Alchornea hirtella*, *Bersama lucens*, *Clausena anisata*, *Eugenia natalitia*, *Grumilea capensis*, *Oxyanthus gerrardii*, *Peddiea africana*, *Rawsonia lucida*, *Rothmannia capensis*, *Rinorea natalensis*, and *Tarenna pavettoides*.

The shrub layer is poorly developed in heavily shaded Climax Forest, but wherever a gap in the canopy allows light to penetrate, this community is very dense. The stratum, from 5 to 15 ft. includes such species as *Canthium ciliatum*, *Carissa bispinosa var. acuminata*, *C. wyliei*, *Cryptocarya wyliei*, *Dracaena hookeriana*, *Tricalysia lanceolata* and *Turraea obtusifolia*.

The field layer community, comprising herbs and grasses, is generally poorly developed. Species include: *Chlorophytum sp.*, *Clivia miniata*, *Conostomium natalense*, *Desmodium hirtum*, *D. repandum*, *Dietes vegeta*, *D. butcheriana*, *Haemanthus spp.*, *Isoglossa cooperi*, *Oplismenus hirtellus*, *Panicum laticomum*, *Pseudechinolaena polystachya*, *Olyra latifolia* and *Stangeria eriopus*.

Climbers are infrequent in the Climax Forest; those noted include *Behnia reticulata*, *Dalbergia obovata*, *Entada spicata*, and *Flagellaria guineensis*.

Epiphytes are common and have been noted as particularly abundant on *Harpephyllum caffrum*, *Linociera peglerae*, *Macaranga capensis*, *Podocarpus latifolius* and *Syzygium gerrardii*.

Epiphytic ferns include *Asplenium sandersonii*, *Microsorium punctatum*, *Polypodium sp.* and *Vittaria isoetifolia*.

Orchids are prolific on most large specimens of the trees mentioned above and include *Bolusiella maudae*, *Bulbophyllum sandersonii*, *Cyrtorchis arcuata*, *C. praetermissa*, *Diaphananthe xanthopollinium*, *Mystacidium sp.* and *Polystachya tesselata*.

Other angiospermous epiphytes include *Rhipsalis cassytha* (Cactaceae) *Dermatobotrys saundersii* (Scrophulariaceae) and *Streptocarpus daviesii* (Gesneriaceae).

Bryophyte and lichen epiphytes are particularly abundant but material collected has not yet been identified.

Hemiparasites are not common. *Viscum nervosum* occurs on *Garcinia gerrardii*, *Viscum wyliei* on *Rapanea melanophloeos*, *Loranthus woodii* on *Burchellia bubalina, and Loranthus quinquenervis* on *Erythroxylum pictum*.

Parasitic and saprophytic fungi are very common in the damper parts of the forest. The latter are responsible for the rapid decay of fallen trees and other vegetable material.

Physiognomy of the Climax Forest

Affinity with Tropical Rain Forest is evident from the Climax Forest physiognomy and is best illustrated by the abundance of buttress roots, fluted stems, "drip tips", cauliflorous flowers, and the presence of five recognisable strata.

Buttresses. Nearly all canopy and subordinate tree layer species at Ngoye exhibit some form of buttress. Plank buttresses are best developed in the larger specimens of *Drypetes gerrardii*, *Harpephyllum caffrum* and *Syzygium gerrardii* Plank buttresses have also been noted on *Cedrella odorata* (introduced), *Garcinia gerrardii*, *Linociera peglerae*, *Macaranga capensis*, *Millettia sutherlandii* and *Nectaropetalum zuluense*.

Harpephyllum caffrum especially, and to a lesser degree, *Nectaropetalum zuluense* and *Drypetes gerrardii*, frequently have long lateral roots running superficially on or above the ground. The superficial root system, buttresses, and the absence of tap roots noticed in large trees uprooted by wind, indicate the shallowness of the soil covering the parent rock.

Chrysophyllum viridifolium and *Drypetes gerrardii* generally have deeply fluted stems.

The bark of the forest trees varies considerably according to species. It may be up to 30 mm. thick in upper canopy specimens of *Cussonia chartacea*, or only a few mm. thick in *Ochna arborea* of the subordinate tree layer. The colour of the inner bark may be deep red as in the upper canopy species *Harpephyllum caffrum*, *Macaranga capensis* and *Bridelia micrantha*, or yellow as in *Garcinia gerrardii* of the subordinate tree layer. The sap may be watery red as in *Millettia sutherlandii*, viscous yellow as in *Garcinia gerrardii*, or white as in *Tabernaemontana ventricosa*.

A very small percentage of the shrubs and smaller forest trees have any form of spinescence. Of the larger trees *Scolopia zeyheri* has thorns of several cms. long on the old wood while the prickles on *Fagara capensis* may attain over 10 cm. in length.

Numerous species of forest trees at Ngoye exhibit the tropical forest character of cauliflory. Those noted include *Alchornea hirtella*, *Cassipourea gummiflua var. verticillata*, *Drypetes natalensis*, *Ficus capensis*, *F. quibeba*, *Halleria lucida, and Rapanea melanophloeos.*

Large, simple entire leaves are most common. "Drip tips" are found on most field and shrub strata species and the saplings and coppices of canopy trees. Typical "drip tips" are illustrated in Figure 6.

Unique features of Ngoye Forest

The great scientific importance of Ngoye lies in the link it forms between the tropical forests of Central and East Africa, and the temperate forests of Knysna and Tsitsikama. In addition to the large tropical element shown in floristic composition and physiognomy, the forest's scientific novelty is emphasized by a large endemic flora and fauna.

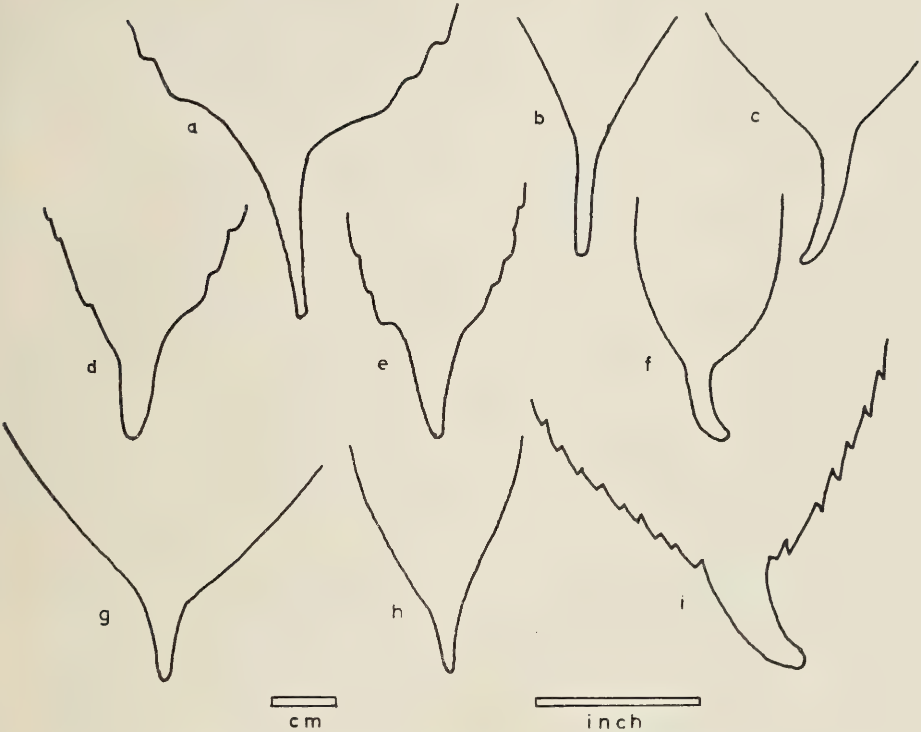

Fig. 6. Leaf apex outlines of typical "drip tips".
a. *Mackaya bella* b. *Rothmannia capensis* c. *Oxyanthus gerrardii* d. *Cassipourea gerrardii* e. *Drypetes gerrardii* f. *Ekebergia capensis* g. *Cassipourea gummiflua* h. *Bequaertiodendron natalensis* i. *Celtis africana.*

The distribution of animal and plant species of common occurrence at Ngoye, but which are very rare or absent elsewhere in South Africa, is given below.

Animals

Scientific Name	Common Name	S. African distribution	Distribution outside South Africa
Cormocephalus granulosus	Ngoye Centipede	—	—
Euryphera achlyus	Forest Green Butterfly	—	Chirunda Forest, S. Rhodesia
Paraxerus ornatus	Ngoye Red Squirrel	—	—
Buccanodon woodwardii	Green Barbet	—	Kenya, Tanganyika
Turturoena delegorguei	Delegorgue's Pigeon	Dargle; Pondoland (v. rare)	East Africa

Plants

Scientific Name	Growth Form	S. African distribution	Distribution elsewhere
Alchornea hirtella	short tree	—	Cameroons, Congo, Moçambique, Tanganyika, Zambia
Asplenium sandersonii	epiphytic fern	N.E. Transvaal	Rhodesia
Bolusiella maudae	epiphytic orchid	—	Kenya
Carissa wyliei	shrub	Port St. Johns	—
Corymborchis welwitschii	ground orchid	Port St. Johns	Moçambique
Encephalartos woodii	cycad (extinct)	—	—
Loranthus woodii	hemiparasite	—	—
Nectaropetalum zuluense	canopy tree	Oribi	—
Olyra latifolia	forest grass	Port St. Johns	Tropical Africa and America
Pseudobersama mossambicensis	canopy tree	Mangusi Forest (Kosi Lake system)	Kenya, Tanganyika, Moçambique
Stictocardia woodii	climber	Gwalaweni Forest (N. Zululand)	—

BIOTIC FACTORS

Animals

The animal ecology of Ngoye forest has not been studied in any detail.

Mammals

The mammalian fauna of the forest is very sparse due to poaching by natives from Native Reserve No. IX. Some of these people have rifles licensed in the days of the Natal Government, while many others have unlicensed fire-arms. Leopard are reputed by the natives to be responsible for occasional stock losses on the western margin. Until recently buffalo frequented the area and old pit traps are still to be seen.

The following mammals occur at the Reserve:

Nsamango monkey	*Cercopithecua mitis labiatus*
Vervet monkey	*Cercopithecus aethiops pygerythrus*
Chacma baboon	*Papio ursinus ursinus*
Bush baby	*Otolemur crassicaudatus garnetii*
Golden mole	*Amblysomys hottentotus*
Banana bat	*Pipistrellus nanus*
Fruit bat	*Rousettus leachii*
Ngoye red squirrel	*Paraxerus ornatus*
Mole rat	*Cryptomys hottentotus*
Tree hyrax	*Dendrophrax arboreus*
Red bush duiker	*Cephalophus natalensis*
Grey duiker	*Sylvicapra grimmia*

Bush buck	*Tragelaphus sylvaticus*
Bush pig	*Potamochoerus porcus*
Reedbuck	*Redunca arundinum*

Birds

The avifauna of the forest is both very interesting and prolific. A list of species occurring at Ngoye would be too lengthy to include in this report. As mentioned above, the occurrence of Delegorgue's pigeon and Woodward's barbet is particularly interesting from a zoogeographic viewpoint.

Seed Dispersal

The development of forest precursor communities and the regeneration of forest gaps formed by the death of old trees depends on the animal distribution of the edible fruits of light tolerant species, including *Antidesma venosum*, *Bequaertiodendron natalense*, *Bridelia micrantha*, *Canthium mundtianum*, *Diospyros lucida*, *D. lycioides*, *Erythrioxylum pictum*, *Eugenia natalitia*, *Ficus spp.*, *Flagellaria guineensis*, *Harpephyllum caffrum*, *Maesa lanceolata*, *Mimusops obovata*, *Rhoicissus tridentata*, *Syzygium cordatum*, *Trema guineensis*, and very many others.

Utilization of the Forest

The forest has long been the main source of timber available to the inhabitants of Native Reserve No. IX. Fernando (1912) considered this form of exploitation insignificant. Today, with the vastly increased population of the native reserve, the illegal extraction of timber by natives, especially on the seldom patrolled western margin, is becoming serious.

Exploitation of indigenous timber by Europeans includes that by John Dunn during the latter half of the nineteenth century. Fernando (1912) reports that slip paths used by Dunn were still evident in the 1910's.

Professor A. W. Bayer (personal communication, 1964) has stated that *Trichelia emetica* was extracted in the latter part of the 19th century and shipped via Port Durnford to a boat-building industry in Durban.

In 1909 the Ngoye Forest Company was granted a concession to extract certain indigenous timber trees from the Reserve. This Company established a mill alongside the forest, and constructed the few forest roads still in existence, but discontinued its activities within a few years. Extraction records are not available, but as far as can be ascertained, approximately 900,000 cubic feet of timber were removed, a good deal of which consisted of pit props for the Rand mines. (King, 1941).

The Forestry Department planted 14.1 acres to numerous introduced timber tree species for test purposes during the years 1912 to 1922. More

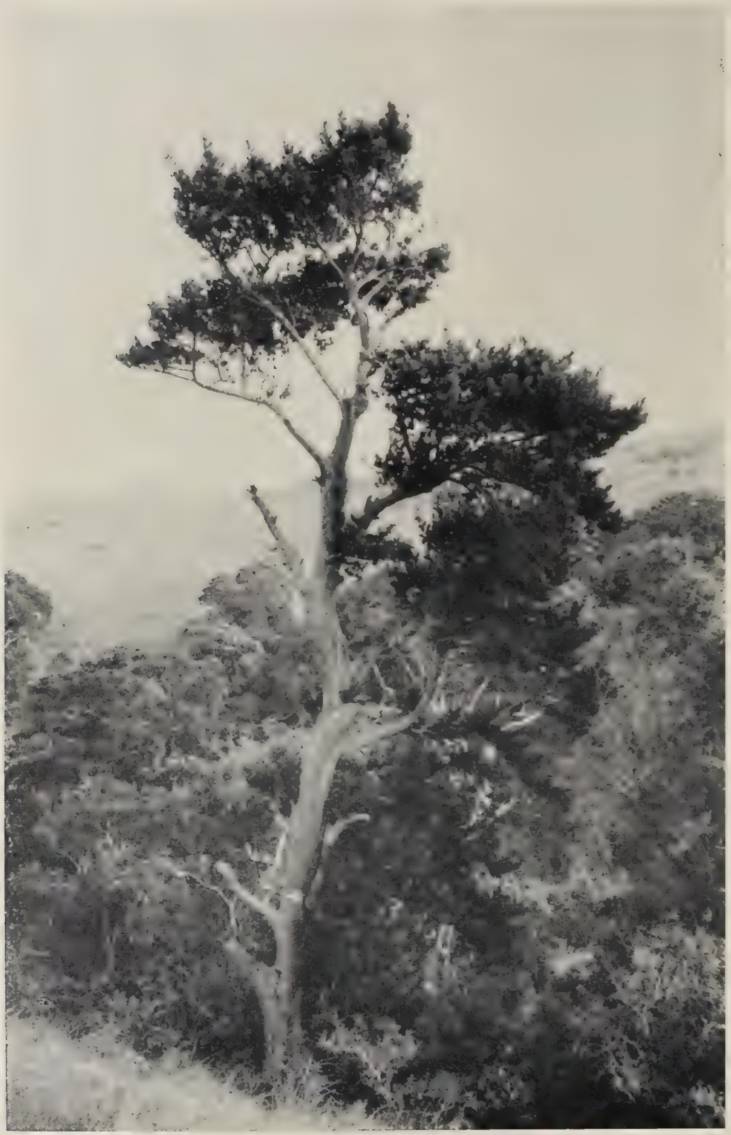

PLATE XXXIII
Damage to specimen of *Podocarpus latifolius* in Native Reserve No. IX. Large branches are periodically cut and dried for firewood.

recently one tenth of an acre has been planted to *Tectona grandis*, the Burma teak, also for test purposes. Since 1924 no further extraction of timber has been legally undertaken.

The feasibility of further afforestation must be considered. Of the 2,500 acres of grassland available to afforestation, not more than 1,000 acres would be accessible to vehicles without a very expensive road construction programme. Afforestation of any Reserve grassveld is not recommended. The grassland is in the first place needed by the natives for grazing and if afforestation did occur the strictest measures would be necessary to prevent deliberate firing of the plantations by the natives deprived of the use of these grasslands. Even if all the available grassland were made use of for afforestation, the area is too small to manage profitably, 3,000 acres being the minimum economic unit. (Mr. Francis, Regional Forest Officer, Zululand South, personal communication, 1964.)

Further, if Ngoye is to be maintained as a natural forest reserve, there is little logic in afforesting it with exotic timber trees.

Cattle, Goats, and Fire

During the past fifty years *Aristida junciformis* has replaced *Themeda triandra* as the dominant of the Ngoye Range Grasslands. The deterioration of the Grasslands may be attributed to two intimately related factors, irregular patch burning and uncontrolled grazing by cattle and goats.

Fires, started by inhabitants of Native Reserve IX to provide winter grazing, are retarded in their spread by numerous natural firebreaks such as streams, forested valleys, swamps and bornhardt outcrops. No rotational programme is followed, some areas being burnt several times per annum, others not for four or five years. The local Zulus regard grazing rights on the Ngoye Range as traditional, and are reluctant to pay the R1.20 per annum per beast levy. Patrolling of the rugged and extensive forest margin by two forest guards is difficult and much illegal grazing occurs in the western areas.

Where small patches are burnt, cattle and goats concentrate and graze the young shoots down to a stubble. Where the grazing pressure is not intense the more palatable species are selectively grazed, and the sour species, due to reduced competition, can multiply more rapidly. Invasion of *Aristida junciformis* into the mixed grassveld of the Reserve results from these factors, and may be seen most clearly near footpaths where most burning occurs.

Transition from grassland to forest on the sinuous 57 mile margin is sharp due to the absence of forest margin seral communities. Destruction of these communities is attributed to the factors responsible for the deterioration of the grasslands, and is accelerated by trampling and browsing by cattle and goats.

Plate XXXIV
Fire damage to scrub and herb community of rock outcrop. July 1964.

Plate XXXV
Forest patch protected from fire by rock outcrops. Note the cattle grazing and browsing on the margin.

Plate XXXVI
Cattle grazing and browsing on forest margin. The tallest trees, up to 55 ft. are *Millettia sutherlandii.*

Absence of forest marginal communities not only prevents further development of forest, but removes the protection they would afford the forest trees from hot, dry, north-east winds.

In order to prevent further retreat of the forest margin, Taylor (1963) with reference to the Nxamalala Forest, recommends afforestation of the marginal grasslands. This is impractical at Ngoye as expressed above. It is suggested that firebreaks be maintained across the mouths of tongues of grassland that extend into the forest. This measure would at least protect some of the margin from fire and would allow the marginal communities to develop and eventually close the gaps.

THE FUTURE OF NGOYE

Before the management of the Reserve is discussed it is necessary to consider the future status and utilization of the forest. Four possibilities exist:

1. To continue the present system of management, with two African Forest Guards controlling 9,648 acres; and to allow deterioration of the grasslands, forest margin and forest, to continue.
2. To hand the administration of the Reserve over to the Bantu Authorities for disposal as they think fit.
3. To afforest the grasslands and manage the Reserve for its timber value.
4. To conserve the Reserve as a Scientific Research Area.

The first possibility mentioned above is clearly untenable. Regarding the second, the contention that the rural Bantu will value and preserve indigenous forests handed over to them, is pure fallacy. The destruction of remnant forest patches in Native Reserve No. IX illustrates this point. The inhabitants are using the timber for domestic purposes, and the rich but short-lived soils of

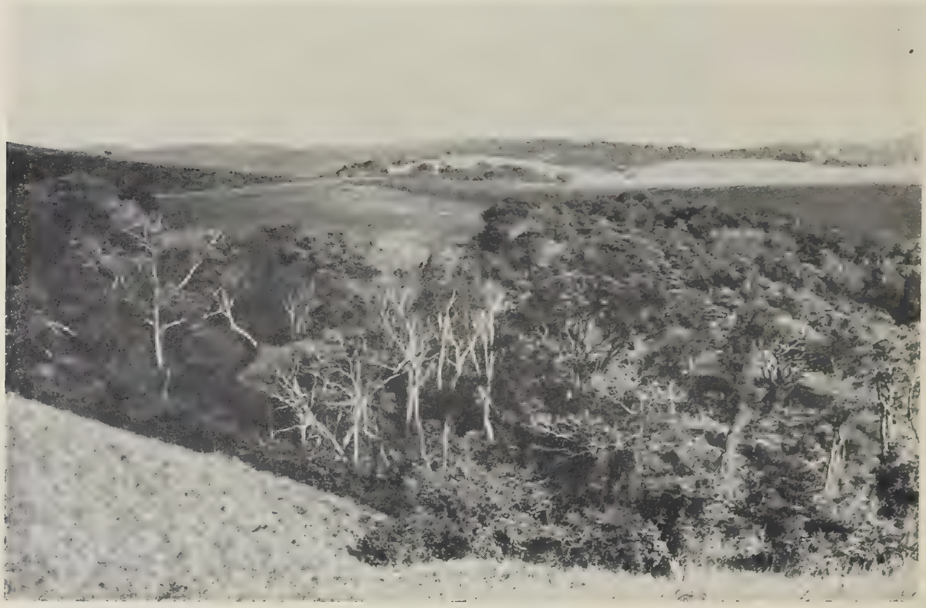

PLATE XXXVII
Forest patch in Native Reserve No. IX being cleared of undergrowth for crop cultivation.
July 1964.

cleared areas for crop growing. The impracticability of afforestation of the grasslands has been discussed under Biotic Factors. The fourth possibility must be discussed in greater detail.

From a scientific viewpoint Ngoye Forest is of inestimable value. The unique flora and fauna of the Reserve has been described above. Ngoye is undoubtedly the most valuable forest in Natal from phyto- and zoogeographic considerations. It links the tropical elements of forests in Mocambique with the sub-tropical and temperate forests of Pondoland and Knysna. No other forest in Natal has as many endemic and tropical species as has Ngoye.

The socio-economic importance of conservation is concisely and excellently discussed by F. F. Darling (1964, p. 39) to which I refer the reader. Where unwise management results in deterioration of the human habitat it is vital to have a conserved area for comparison to assess the extent of degradation. The grasslands of Ngoye illustrate this point. As mentioned above, the Native Reserve Grasslands have been reduced from productive *Themeda triandra* to useless *Aristida junciformis*, the only remnants of *Themeda triandra* on the range occurring in the better protected parts of the Forest Reserve.

Were it not for Forest Department protection of a representative area of the district, the entire region would today be dominated by *Aristida junciformis* without a hint of the area's potential as *Themeda triandra* Grassland. That conservation of Ngoye Forest Reserve has to date been of great value to the human population of the area has not yet been appreciated. This value can only be made real to the human population if practical eco- agricultural methods, based on studies in the Reserve, are implemented.

It must be remembered that the Reserve is surrounded by Native Reserve No. IX. Any management programme should avoid unnecessary friction with the inhabitants of the native reserve. Restricted grazing and the cutting of thatch grass should be permitted at a nominal cost. Poaching on the periphery of the reserve is especially difficult to control, but it may be borne in mind that, with the possible exception of the Ngoye red squirrel, the rarer plants and animals of the forest are not used by the natives and therefore do not require special protective measures. The management of the reserve as a scientific research area would not necessitate the fencing of the boundaries or discontinuation of grazing. Selected areas may need complete protection for study purposes, but in general the standard of living of the local native could only be improved by scientific studies regarding vegetation management at Ngoye.

The recommendations discussed below may be implemented at very small cost, and would serve as a base for conservation of the Reserve as a Scientific Research Area.

The repair of the old Ngoye Timber Company road to the Forest Guard Camp is necessary, primarily for the easy access of fire-fighting or poaching control teams in emergencies, but also for the transport of scientific recording materials to the forest. The rights of way through the forest used by the local natives should also be more clearly defined.

Where necessary the existing corner and line beacons should be repaired. Further line beacons should be placed at a maximum of 500 yard intervals and a 30 yard wide firebreak should be maintained to demarcate the boundary more clearly.

The present Forest Guard Camp is in bad repair and the erection of permanent married quarters for two Forest Guards is necessary. At least one camp must be established in the extreme west of the Reserve. The grazing and grass-cutting levies should be revised and, if necessary, strictly enforced at the earliest convenience, foregoing retrospect payments.

The policy of any burning programme should be to avoid the deleterious effects of patch burning or intense fires following long fire-free periods. In regard to the grasslands, regular extensive spring burning is suggested. Accidental fires should be allowed to burn at least one hundred acres but should, if possible, be prevented from entering forest margin communities.

Self-recording weather stations should be established at suitable points on the Ngoye Range at the earliest opportunity. Such recordings are essential for any long-term scientific project conducted at the Reserve.

In addition to the establishment of permanent Forest Guard Camps, it would be a great advantage to erect simple accommodation, in the form of a rondavel, for visiting scientists and officials.

It is essential that the entire Ngoye Forest Reserve, as proclaimed in 1913, be conserved in perpetuity. The reduction of its size should never be allowed, for not only is its area of insignificant proportions in relation to the size of Zululand, but the reduction in size of any natural community is ecologically undesirable. A short passage from F. Fraser Darling (1960, p. 56), is appropriate.

"A natural habitat, especially a forest which depends to some extent upon the interior temperature-humidity relationship, must exist unbroken over a considerable area if it is to survive and regenerate; this is one of the axioms emerging from greater understanding of the structure and physiology of ecosystems, and one which must be learnt by governments in apportioning land and devising land use programmes."

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CHROMOSOME NUMBERS IN THE COMPOSITAE. IX AFRICAN SPECIES

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Abstract

Eighty species of African Compositae are examined and their chromosome counts tabulated.

Introduction

Previous contributions to this series have dealt with species from North America. Bud material and voucher specimens on which the present paper is based were collected by the junior author in 1962–63 while engaged in field work in Africa.

Chromosome counts were made from pollen mother cell squashes. Buds were collected from plants growing in the field and placed in a freshly mixed solution of 4 parts chloroform: 3 parts absolute alcohol: 1 part glacial acetic acid, and allowed to remain for a period varying from one to several weeks. Young anthers were subsequently removed and squashed in acetocarmine. Camera lucida drawings were made at an initial magnification of *ca.* 2000 diameters.

Vernonieae

Vernonia ($x = 9, 10, 16, 17$). This predominantly pantropical genus is reportedly composed of over 500 species (Gleason, 1923). Including the present counts, approximately 16 species are known chromosomally (Cave, 1956–61). In spite of this limited sampling, several basic chromosome numbers have emerged. African species of the Sections *Strobocalyx* and *Decaneurum* are known with $n = 9$ and $n = 10$, respectively. The American Section *Lepidaploa* has at least one species with $n = 17$ (Turner, unpublished); the South American species, *V. nudiflora* Less., of this same Section, is reported with $n = 16$ (Cave, 1959) while *V. platensis* Less. is reported with $n = 20$ (Cabrera, 1944). Chromosome counts for the widespread pantropical taxon, *Vernonia cinerea*, which is the sole species of the Section *Tephrodes*, have been reported from 3 different continents as diploid with $n = 9$ (Africa: Miege, 1960, and present paper; Asia: Chuang *et al.*, 1962; Grant, 1953; and North America: Turner & King, 1964). Our counts for *Vernonia glabra* ($n = 10$) agree with that reported by Riley and Hoff (1961). In view of the limited number of counts available, it would be premature to assess the value of chromosome numbers as systematic guides within *Vernonia*, but it is obvious that the variation already described is sufficiently interesting to warrant a more intensive cytological investigation of the genus.

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Chromosome counts for *Erlangia* ($n = 10$) and *Ethulia* ($n = 10, 20$) are first reports for these genera.

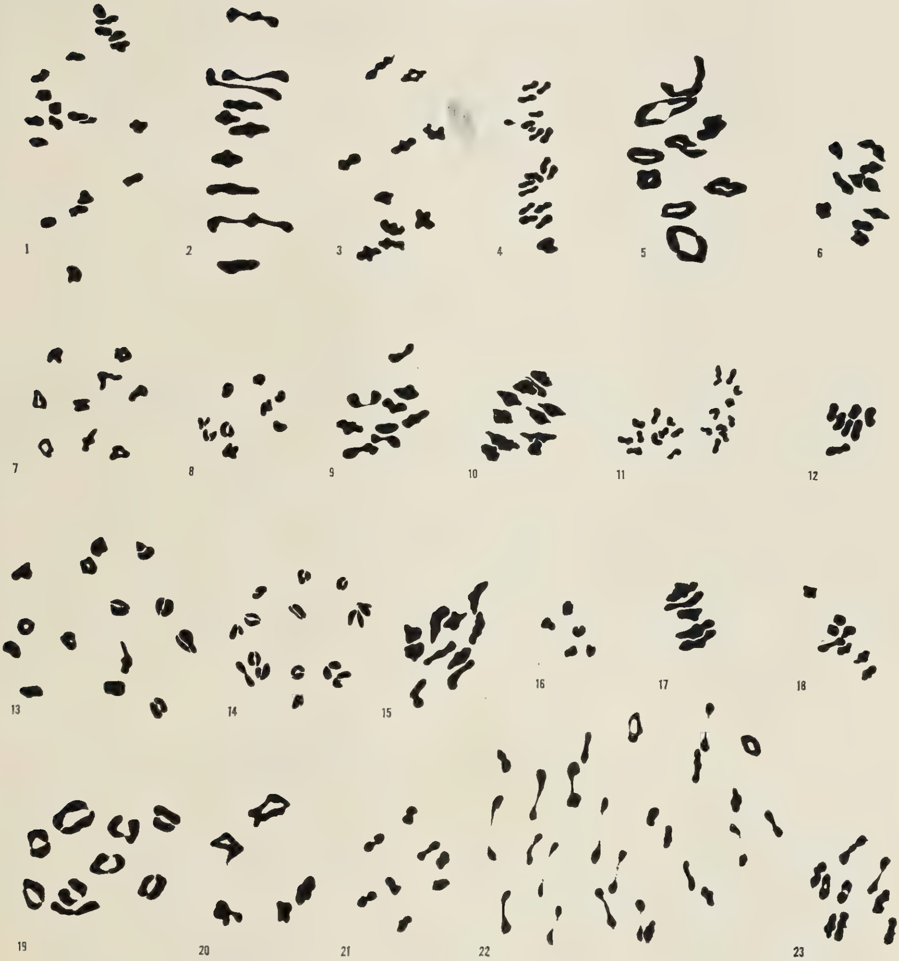
Eupatorieae

Ageratum conyzoides ($n = 20$). Collections of this widespread, weedy, species have been reported as tetraploid from India (Mitra, 1947), Central America (Turner, unpublished) and Africa (present paper). Darlington and Wylie (1956) list only a single diploid count ($n = 10$) for the taxon, reported by a Japanese worker in 1916.

Mikania cordata ($n = 18$). Mangenot and Mangenot (1957) have reported two other African collections of this species to be diploid with $n = 18$ (reported as *M. scandens*). Mitra (1947) reported the chromosome number of *M. cordata* to be $2n = 38$; however, the drawing documenting his count is not convincing since it appears to show $2n = 36$. Our meiotic figure (Table 1) shows 18 bivalents. One of the bivalents is quite large and might be interpreted as two overlapping chromosome pairs; however, since a number of metaphase meiotic cells from the same bud showed essentially the same chromosomal configuration, we feel the number $n = 18$ to be the correct interpretation. Turner *et al.* (1962) have reported a chromosome number of $n = 17$ for *Mikania gonzalezii*, the only other species of the genus for which counts are available.

Astereae

Aster subulatus ($n = 10$). This now widespread, weedy species is native to North and South America. The senior author has counted at least 10 collections from 5 Mexican states and Guatemala; all were diploid with $n = 5$. A closely related taxon, *A. squamatus* (Spreng.) Hieron., from Argentina is reportedly tetraploid with $n = 10$ (Darlington and Wylie, 1956). Shinners (1953) treated this latter species as synonymous with *A. subulatus* var. *australis* (Gray) Shinners, the more common populational form of *A. subulatus* in South America. It would appear that the present material (Table 1) if introduced into Swaziland, was from that region. Huziwara (1958) has reported *A. subulatus* to be diploid with $2n = 18$ (or $n = 9$); his material was reportedly collected at Kobe, Japan. Huziwara's counts should be held suspect until his voucher material, if available, can be examined; in any case, his figures showing the karyotypes of *A. subulatus* and the very closely related, if not conspecific, *A. exilis*, are very different and if his material is correctly determined, some interpretation would be in order.



FIGS. 1-23

Meiotic chromosomes of species of Compositae, Xca. 2000:
1. *Ethulia conyzoides* ($n = 20$)—2. *Vernonia aemulans* ($n = 10$)—3. *Vernonia glabra* ($n = 10$)—4. *Mikania cordata* ($n = 18$)—5. *Aster bakeranus* ($n = 9$)—6. *Aster subulatus* ($n = 10$)—7. *Nidorella hottentotica* ($n = 9$)—8. *Nidorella resedifolia* ($n = 9$)—9. *Nidorella welwitschii* ($n = 9$)—10. *Blumea mollis* ($n = 11$)—11. *Geigeria burkei* ($n = 10$; metaphase, division II)—12. *Helichrysum decorum* ($n = 7$)—13. *Coreopsis grandiflora* ($n = 14$)—14. *Melanthera scandens* ($n = 15$)—15. *Inezia integrifolia* ($n = 10$)—16. *Senecio discifolius* ($n = 5$)—17. *Senecio hockii* ($n = 5$)—18. *Berkheya setifera* ($n = 8$)—19. *Haplocarpha scaposa* ($n = 9$)—20. *Hirpicium diffusum* ($n =$ ca. 5)—21. *Ursinia nana* ($n = 8$)—22. *Gerbera discolor* ($n = 25$)—23. *Heterachaena massavensis* ($n = 9$).

Microglossa angolensis (n = ca. 18). The taxon apparently possesses both diploid and tetraploid population and/or individuals since Mangenot and Mangenot (1962) reported a diploid collection from Africa with $n = 9$. Chuang *et al.* (1962) have also reported an asiatic species of *Microglossa* with $n = 9$.

Chromosome counts for the genera *Dichrocephala* ($n = 9$), *Nidorella* ($n = 9$), and *Psiadia* ($n = 9$) are first reports.

Inuleae

Blumea mollis ($n = 11$). Only 3 counts are available for the genus. Shetty (1961) has reported an Indian species to be diploid with $n = 10$ and Chuang *et al.* (1962) have reported a Taiwanian species with $n = 10$. Chromosome counts for *Geigeria* ($n = 10$) have not been reported previously.

Heliantheae

Chromosome counts (Table 1) for species of *Coreopsis* ($n = 14$), *Melanthera* ($n = 15$), *Spilanthes* ($n = 13, 26$) and *Tridax* ($n = 18$) agree with previously reported counts for these genera (Darlington and Wylie, 1956; Turner *et al.*, 1961).

Anthemideae

Chromosome counts for 20 of the approximately 55 genera of this tribe have been reported. Basic numbers of $x = 8, 9, 17$ or combinations of these have been found for all of the taxa except *Cotula* with $x = 10$ and 13 (Hair, 1962; a base number of $x = 5$ was hypothesized but species at the $n = 5$ level have not been reported), *Centipeda* (Hair, 1963), and *Inezia* (Table 1). The latter 2 genera have basic numbers of $x = 10$.

Senecioneae

The chromosome counts for *Senecio abyssinicus*, *S. discifolius*, and *S. hockii* are noteworthy in that they are diploid with $n = 5$. All other species of *Senecio* examined to date have had chromosome numbers on a base of $x = 10$[3], 22, 23 or 24. Most workers, including Arano (1962), have postulated an ancestral basic number of $x = 5$ for the genus (and tribe); Ornduff *et al.* (1963), however, have proposed an ancestral basic number of $x = 10$ for these taxa, the number $x = 5$ having been derived through aneuploid loss. Their argument stems primarily from the observation that taxa with $x = 5$ are rare (found in only 5 or 6 annual species of the closely related genera *Senecio* and *Emilia*). They further argue that polyploid taxa with odd numbers of $n = 15, 25$, etc. are not common in the genus, and these should be relatively common if the basic number were $x = 5$.

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[3] A single species, *S. arenarius*, is known to possess $n = 9$. According to Afzelius (1949) this species "belongs to the flora of the Cape Province and is often cultivated in gardens . . . It resembles *S. elegans* L. which has $n = 10$ and also originates from the Cape Province."

Senecio, with over 2,000 species, is probably the largest and most widely distributed genus of vascular plants. Hoffmann (1894) treated the taxon as consisting of 2 subgenera, *Emilia* and *Senecio*. Chromosome numbers of $n = 5$ and $n = 10$ have been found in both of these subgenera. Species with chromosome numbers of $n = 9$[3], 8, 7 or 6 have not been reported, in spite of the fact that diploid taxa with $n = 10$, at least in Africa, are relatively common. In such a large successful genus, one would expect at least some species with chromosome numbers of 6 through 8 to have persisted, especially if the taxa with $n = 5$ are of relatively recent origin. Actually, Ornduff *et al.* admit to the tetraploid nature of $n = 10$ in *Emilia*; presumably the basic number for this genus is $x = 5$. But since *Emilia* may be treated on morphological grounds as a subgenus of *Senecio* and since the subgenus, *Senecio*, also has species with $n = 5$ and 10, it would appear more consistent with reason to accept a base of $x = 5$ for *Senecio* also. Obviously if future workers find species of *Senecio*, which are closely related to the $n = 5$ species, with n numbers of 9, 8, 7 or 6, arguments for a basic number of $x = 5$ would be weakened. Commonness of a character is not in itself an indication of primitiveness. Indeed if a primitive character, in this case an ancestral chromosome set, is to be preserved within a rapidly evolving, successful phylad, the character concerned ought to be rare[1]. As concerns the preservation of an ancestral diploid genome in a group like *Senecio*, one would expect such a set to be retained in those taxa which are morphologically "advanced", for the ancestral morphological forms ought to be retained best in those taxa which are at the polyploid level where multiple genes might form effective "buffers" (Stebbins, 1950) against additional morphological changes due to mutational forces.

It is not difficult to account for the absence of taxa with numbers of $n =$ 15, 25, etc., if one can accept the tetraploid nature of species with $n = 10$. To obtain taxa with $n = 15$ would require the gametic combinations of $n =$ 10 and $n = 5$: a sporophytic triploid condition such that 5 univalents would be expected at meiosis and even if complete autosyndesis somehow occurred there would still be an odd univalent which might cause effective selection against the establishment of triploid individuals (Darlington, 1956). This same reasoning can be used to account for the general absence of taxa with n numbers of 25, 35, etc. Triploids and/or pentaploids on a base of $x = 5$ might be expected in the genus *if* apomixis were a factor in the speciation process; (cf. *Erigeron* with $n = 9, 18, 27$, etc.) but so far as we are aware apomixis has not been reported in the genus.

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[3] For example, well defined phyllaries (or chaff) on the receptacle is looked upon as a primitive character. In the very natural genus *Hymenoppappus* ($x = 17$) with 25 taxa, only a single species possesses chaff (Turner, 1956). In the Compositae generally, chaff is the exception rather than the rule (even the more woody species lack chaff, e.g., *Baccharis*); yet hardly any current worker questions the assumption that naked receptacles are the more advanced.

Arctotideae

Berkheya ($n = 8$). Two other species are reported to have chromosome numbers of $n = 7$ (Darlington and Wylie, 1956). The chromosome counts for species of *Haplocarpha* ($n = 9$), *Hirpicium* ($n =$ ca. 5) and *Ursinia* ($n = 8$) are new generic reports.

Mutisieae

Gerbera discolor ($n = 25$). Including the present, only four species of this genus have been counted (Darlington and Wylie, 1956): two Asiatic species, belonging to the Section *Gerbera*, are diploid with $n = 23$; while two African species, belonging to the Section *Lasiopus*, are diploid with $n = 25$.

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Table 1

Species of Compositae examined for Chromosome Number

Tribe Vernonieae

Species	Location and Voucher	n Number
Erlangea cordifolia (Benth. ex Oliv.) S. Moore	KENYA: Central Prov., Royal Nairobi National Park, *Lewis* 5945.	*ca.* 10 *ca.* 10
Erlangea tomentosa S. Moore	KENYA: Coast Prov., Taita Dist., S.E. Slope of Mt. Vuria, *Lewis* 5936.	10
Erlangea tomentosa S. Moore	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate. *Lewis* 6045.	*ca.* 10*
Ethulia conyzoides L.	UGANDA: Buganda Prov., Mengo Dist., 3.5 miles N.E. of Kampala, *Lewis* 6025.	*ca.* 10*
Ethulia conyzoides L.	S. AFRICA: Natal Prov., Hlabisa Dist., Charters Creek, *Lewis* 6302.	20 (Fig. 1)
Vernonia brachycalyx O. Hoffm.	UGANDA: Northern Prov., Karamoja Dist., base of Mt. Moroto, *Lewis* 5992.	10
Vernonia cinerea (L.) Less.	TANGANYIKA: Tanga Region, Tanga Area, 4 miles N. of Tanga, *Lewis* 6061.	9
Vernonia aemulans Vatke	N. RHODESIA: Northern Prov., Abercorn Dist., 5.5 miles S.W. of Abercorn, *Lewis* 6121.	10 (Fig. 2)
Vernonia glabra (Steetz) Vatke	S. RHODESIA: Salisbury Dist., Salisbury Cranborne, *Lewis* 6256.	10 (Fig. 3)

* Indicates the occurrence of one to several fragments.

Vernonia oligocephala (DC.) Sch. Bip ex Walp.	S. AFRICA: Transvaal Prov., Potgietersrust Dist., 2 miles S.W. of Potgietersrust. *Lewis* 6262.	*ca.* 9	
Vernonia oligocephala (DC.) Sch. Bip. ex Walp.	TANGANYIKA: Southern Highlands Region, Mbeya Area, Mbeya Range, *Lewis* 6073.	*ca.* 20	
Vernonia viatorum S. Moore	N. RHODESIA: Northern Prov. ,Abercorn Dist., Sunzu Gorge, *Lewis* 6095.	10	

Tribe Eupatorieae

Ageratum conyzoides L.	UGANDA: Eastern Prov., Buso Dist., 3 miles W. of Busesa, *Lewis* 6028.	20	
Ageratum conyzoides L.	KENYA: Central Prov., Meru Dist., 8 miles N.E. of Runyenje's, *Lewis* 5912.	20	
Ageratum conyzoides L.	TANGANYIKA: Tanga Region, Tanga Area, 4 miles N. of Tanga, *Lewis* 6060.	20	
Eupatorium africanum Oliv. ex Hiern.	TANGANYIKA: Southern Highlands Region, Iringa Area, 4.5 miles N.E. of John's Corner, *Lewis* 6068.	10	
Mikania cordata (Burm. f.) B. L. Robins.	KENYA: Coast Prov., Taita Dist., Ollaiani River, *Lewis* 6034.	18	(Fig. 4)

Tribe Astereae

Aster bakerianus Burt Davy ex C. A. Smith	S. AFRICA: Natal Prov., Estcourt Dist., 3.2 miles W.N.W. of Estcourt, *Lewis* 6272.	9	
Aster bakerianus Burt Davy ex C. A. Smith	TANGANYIKA: Southern Highlands Region, 7.1 miles E. of Mbeya, *Lewis* 6084.	9	(Fig. 5)
Aster hyssopifolius Berg.	TANGANYIKA: Southern Highlands Region 7.1 miles E. of Mbeya, *Lewis* 6081.	18	
Aster subulatus Michx.	SWAZILAND: Komati River, by Forbes Reef-Piggs Peak Rd., *Lewis* 6327.	10	(Fig. 6)
Conyza aegyptiaca (L.) Ait.	N. RHODESIA: Northern Prov., Abercorn Dist., Abercorn, *Lewis* 6107.	9	
Conyza newii Oliv. & Hiern.	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate, *Lewis* 6050.	9	
Conyza newii Oliv. & Hiern.	KENYA: Coast Prov., Taita Dist., S.E. slope of Mt. Vuria, *Lewis* 5935.	9	
Conyza pinnata (L. f.) O. Ktze.	S. AFRICA: Natal Prov., Lions River Dist., 1 miles S. of Rosetta, *Lewis* 6276.	9	
Conyza podocephala D.C.	S. AFRICA: Transvaal Prov., Pretoria Dist., Pretoria, Wonderboom, *Lewis* 6343.	9	
Conyza steudelii Sch. Bip.	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate, *Lewis* 6038.	9*	
Dichrocephala intergrifolia (L. f.) O. Ktze.	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate, *Lewis* 6041.	9	
Microglossa angolensis Oliv. & Hiern.	TANGANYIKA: Southern Highlands Region, 17 miles N.N.W. of Tukuyu, *Lewis* 6090.	*ca.* 18	
Nidorella auriculata DC.	N. RHODESIA: Northwestern Prov., Mwinilanga Dist., 2 miles W. of Ikelengi, *Lewis* 6191.	9	
Nidorella hottentotica DC.	S. AFRICA: Transvaal Prov., Pretoria Dist., Pretoria, Wonderboom, *Lewis* 6350.	9	(Fig. 7)

Nidorella resedifolia DC.	N. RHODESIA: Northern Prov., Abercorn Dist., Sunzu Gorge, *Lewis* 6096.	9	(Fig. 8)
Nidorella welwitschii S. Moore	ANGOLA: Mexico Dist., 2 miles W. of Jimbe River by Caianda-Mwinilunga Rd., *Lewis* 6217.	9	(Fig. 9)
Psiadia arabica Jaub. & Spach	KENYA: Central Prov., Royal Nairobi National Park, *Lewis* 5940.	9	

Tribe Inuleae

Blumea mollis (*D. Don*) Merr.	CONGO: Katanga Prov., Haut-Katanga Dist., 6 miles N.E. of Mokambo, *Lewis* 6127.	11	(Fig. 10)
Blumea mollis (D. Don) Merr.	N. RHODESIA: Southern Prov., Livingstone Dist., Victoria Falls, *Lewis* 6243.	ca. 11	
Geigeria burkei Harv.	S. AFRICA: Transvaal Prov., Pretoria Dist., Pretoria, Wonderboom, *Lewis* 6349.	10	(Fig. 11)
Gnaphalium luteo-alba L.	N. RHODESIA: Northern Prov., Abercorn Dist., Chilunoma River, nr. Abercorn. *Lewis* 6111.	7	
Helichrysum decorum DC.	S. AFRICA: Natal Prov., Durban Dist., Isipingo Beach, *Lewis* 6289.	7	(Fig. 12)
Helichrysum foetidum (L.) Cass.	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate, *Lewis* 6044.	7	
Helichrysum mixtum O. Hoffm.	S. AFRICA: Natal Prov., Hlabisa Dist., 3.7 miles W. of Charters Creek, *Lewis* 6307.	7	
Helichrysum panduratum O. Hoffm.	S. AFRICA: Natal Prov., Durban Dist., Isipingo Beach, *Lewis* 6287.	7	

Tribe Anthemideae

Anthemis tigreensis J. Gay ex A. Rich.	KENYA: Central Prov., Nanyuki Dist., N.W. slope of Mt. Kenya, *Lewis* 5919.	9	
Inezia integrifolia (Klatt) Phillips	S. AFRICA: Transvaal Prov., Barberton Dist., 21 miles S.E. of Barberton, *Lewis* 6336.	10	(Fig. 15)

Tribe Heliantheae

Aspilia africana (Pers.) Adams	KENYA: Coast Prov., Taita Dist., Ollaiani River, *Lewis* 6035.	34 ± 2	
Bidens pilosa L. var. *minor* Sheriff	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate, *Lewis* 6043.	38 ± 2	
Bidens taitensis Sheriff	KENYA: Coast Prov., Taita Dist., S.E. slope of Mt. Vuria, *Lewis* 5934.	23 ± 1	
Coreopsis grandiflora Nutt.	SWAZILAND: Mbabane, Mbabane River, *Lewis* 6319.	14	(Fig. 13)
Galinsoga parviflora Cav.	ETHIOPIA: Harar Prov., N.W. edge of Lake Alemaya, *Lewis* 5875.	ca. 8	
Melanthera scandens (Schumach. & Thonn.) G. Roberty	KENYA: Coast Prov., Taita Dist., Ollaiani River, *Lewis* 6033.	15	(Fig. 14)
Spilanthes mauritiana (Rich. ex Pers.) DC.	UGANDA: Northern Prov., Karamoja Dist., base of Mt. Moroto, nr. Moroto, *Lewis* 5994.	13	
Spilanthes uliginosa Sw.	TANGANYIKA: Tanga Region, Tanga Area, 7 miles N. of Tanga *Lewis* 6054.	ca. 26	
Tridax procumbens L.	KENYA: Coast Prov., Taita Dist., Kyanite Mine, *Lewis* 6037.	18	

Tribe Senecionieae

Cineraria grandiflora Vatke	KENYA: Central Prov., Nanyuki Dist., N.W. slope of Mt. Kenya, *Lewis* 5921.	20
Cineraria grandiflora Vatke	TANGANYIKA: Southern Highlands Region, Mbeya Area (ca. 11 ml. N.E. of Mbeya), *Lewis* 6077.	ca. 20
Cassocephalum crepidiodes (Benth.) S. Moore	UGANDA: Eastern Prov., Buso Do., 3 miles W. of Busesa, *Lewis* 6029.	ca. 20
Crassocephalum montuosum (S. Moore) Milne-Redh.	TANGANYIKA: Tanga Region, Lushoto Area, Herkulu Tea Estate (ca. 7 miles E. of Soni), *Lewis* 6039.	10
Crassocephalum rubens (Jacq.) S. Moore	TANGANYIKA: Southern Highlands Region, Mbeya Area, 7.1 miles E. of Mbeya, *Lewis* 6082.	10
Crassocephalum rubens (Jacq.) S. Moore	N. RHODESIA: Northwestern Prov., Mwinilunga Dist., 1.4 miles E. of Angola—N.R. border nr. Mujileshi River, *Lewis* 6137.	10
Crassocephalum rubens (Jacq.) S. Moore	N. RHODESIA: Northwestern Prov., Mwinilunga Dist., 4 miles N. of Kalene Mission, *Lewis* 6205, 6208.	ca. 10
Crassocephalum vitellinum (Benth.) S. Moore	TANGANYIKA: Southern Highlands Region, S. slopes of Poroto Mts., *Lewis* 6086.	ca. 10
Emilia coccinea (Sims) G. Don	N. RHODESIA: Northwestern Prov., Mwinilunga Dist., Mujileshi River, 5-6 miles E. of Angola—N.R. border, *Lewis* 6168.	5 5 5
Emilia integrifolia Bak.	N. RHODESIA: Northern Prov., 13 miles S. of Fort Roseberry, *Lewis* 6126.	5
Emilia protracta S. Moore	S. RHODESIA: Wankie Dist., Victoria Falls, *Lewis* 6245.	5
Senecio abyssinicus Sch. Bip.	N. RHODESIA: Northern Prov., Chilunoma River, nr. Abercorn, *Lewis* 6110.	5
Senecio albanensis DC.	S. AFRICA: Natal Prov., Estcourt Dist., Drakensberg Mts., base of Mt. Champagne, *Lewis* 6267.	10
Senecio bupleuroides DC.	S. AFRICA: Natal Prov., Estcourt Dist., 3.2 miles W.N.W. of Estcourt, *Lewis* 6273.	20
Senecio discifolius Oliv.	KENYA: Rift Valley Prov., Uasin Gishu Dist., Kipharren River, *Lewis* 6032.	5 (Fig. 16)
Senecio hockii de Wild. & Muschl.	TANGANYIKA: Southern Highlands Region, 7.1 miles E. of Mbeya, *Lewis* 6083.	5 (Fig. 17)
Senecio paniculatus Berg.	S. AFRICA: Natal Prov., Durban Dist., Isipingo Beach, *Lewis* 6282.	10
Senecio paucicalyculatus Klatt	S. AFRICA: Natal Prov., Estcourt Dist., 3.8 miles W.N.W. of Estcourt, *Lewis* 6271.	21 ± 1
Senecio pellucidus DC.	S. AFRICA: Natal Prov., Estcourt Dist., Drakensberg Mts., base of Mt. Champagne, *Lewis* 6265.	10
Senecio pellucidus DC.	SWAZILAND: Mbabane, Mbabane River, *Lewis* 6317.	10
Senecio pterophorus DC.	SWAZILAND: Mbabane: Mbabane River, *Lewis* 6318.	10
Senecio purpureus L.	ANGOLA: Moxico Dist., 2 miles W. of Jimbe River by Caianda-Mwinilunga Rd., *Lewis* 6219.	10

Senecio roseiflorus R. E. Fries	KENYA: Central Prov., Nanyki Dist., N.W. slope of Mt. Kenya, *Lewis* 5918.	*ca.* 10	
Senecio sarmentosus O. Hoffm.	KENYA: Central Prov., Meru Dist., 9 miles N.E. of Runyemje's, *Lewis* 5913.	20	
Senecio serratuliodes DC.	S. AFRICA: Transvaal Prov., Pretoria Dist., near Fountain Valley, Pretoria, *Lewis* 6353.	10	
Senecio torticaulis Merscm.	S. RHODESIA: Salisbury Dist., Salisbury, Cranborne, *Lewis* 6255.	10	
Senecio variabilis Sch. Bip.	TANGANYIKA: Southern Highlands Region, Mbeya area, Mbeya range, *Lewis* 6076.	30	
Senecio variabilis Sch. Bip.	N. RHODESIA: Northern Prov., Abercorn Dist., Sunzu Gorge, *Lewis* 6100.	10	
Senecio sp.	N. RHODESIA: Northwestern Prov., Mwinilunga Dist., 4 miles N. of Kalene Mission, *Lewis* 6211.	*ca.* 20	
Senecio sp.	S. AFRICA: Natal Prov., Estcourt Dist., Drakensberg Mts., base of Mt Champagne, *Lewis* 6268.	10	
Senecio sp.	SWAZILAND: Mbabane, Mbabane River, *Lewis* 6316.	10	

Tribe Arctotideae

Berkheya erysithales (DC.) Roessl.	S. AFRICA: Natal Prov., Hlabisa Dist., 4.3 miles W. of Charters Creek, *Lewis* 6308.	8	
Berkheya setifera DC.	S. AFRICA: Natal Prov., Estcourt Dist., Drakensberg Mts., base of Mt. Champagne, *Lewis* 6269.	8	(Fig. 18)
Berkheya speciosa (DC.) O. Hoffm.	S. AFRICA: Natal Prov., Hlabisa Dist., Charters Creek, *Lewis* 6301.	8	
Haplocarpha scaposa Harv.	ANGOLA: Moxico Dist., 2 miles W. of Jimbe River by Caianda-Mwinilunga Rd., *Lewis* 6218.	9	
Haplocarpha scaposa Harv.	S. AFRICA: Natal Prov., Estcourt Dist., 3.8 miles W.N.W. of Estcourt, *Lewis* 6270.	9	(Fig. 19)
Hirpicium diffusum (O. Hoffm.) Roessler	KENYA: Coast Prov., Taita Dist., Tsaro West National Park, Kyanita Mine. *Lewis* 6036,	*ca.* 5	(Fig. 20)
Ursinia nana DC.	S. AFRICA: Transvaal Prov., Pretoria Dist., Koedoespoort, *Lewis* 6352.	8	(Fig. 21)

Tribe Calenduleae

Osteospermum monocephalum (Oliv. & Hiern.) T. Norl.	TANGANYIKA: Southern Highlands Region, Mbeya Area, *ca.* 11 miles N.E. of Mbeya, *Lewis* 6079.	*ca.* 16	

Tribe Mutisieae

Gerbera discolor Sond.	S. RHODESIA: Salisbury Dist., Salisbury, Makadusi River, *Lewis* 6258.	25	(Fig. 22)

Tribe Cichorieae

Crepis iringensis Babc.	TANGANYIKA: Southern Highlands Region, Mbeya Area, *ca.* 11 miles N.E. of Mbeya, *Lewis* 6075.	4	
Heterachaena massavensis Fresen.	ETHIOPIA: Harar Prov., 7.4 Km E. of Giggiga, *Lewis* 5890.	9	(Fig. 23)

NOTES ON ACACIA SPECIES IN SOUTHERN AFRICA

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Abstract

Acacia retinens Sim and *A. gillettiae* Burtt Davy have proved to be a single species. The former which was published earlier takes precedence and the latter is transferred to synonymy.

Points of similarity and difference between *A. hereroensis* and *A. mellei* are discussed and the latter transferred to synonymy.

A. retinens Sim.

Sim (1909) described *Acacia retinens* from Portuguese East Africa, citing *Sim* 6391 as the type specimen. This specimen is presumed lost since all recent efforts to locate it have so far failed.

While collecting in Portuguese East Africa Sim allocated certain numbers in the six-thousands to his specimens. Subsequently it has been revealed that specimens collected at the same time were given numbers in the twenty-thousands. It therefore seems probable that Sim gave one number to his original specimens and another to his duplicate specimens. As Sim (l.c.) cited only one number it is not possible to establish what number the duplicates carry. Unfortunately Sim's notebooks (in University of Natal Herbarium) shed no light on this subject. The possibility that a duplicate of the type specimen, bearing a number in the twenty-thousands, exists cannot be precluded but it appears unlikely that such a specimen could be identified as a duplicate of *Sim* 6391 with absolute certainty.

In his description Sim (l.c.) noted that the stipular spines are "often altered by insect parasites into hard swollen spines 3—4 cm long, 1 cm in diameter . . ." These enlarged spines are illustrated in Plate XLA. The description and illustration, plus the finding of a Sim specimen, *Sim* 6285 (NU), bearing the name *A. retinens* Sim (unfortunately without locality), leave no doubt as to what plant Sim had before him.

Burtt Davy (1932) described *A. gillettiae* from the Waterberg District of the Transvaal, citing *Galpin M*114, as the type specimen. Although this specimen bears no enlarged spines the collector's notes carry the comment "readily distinguished by few enlarged spines on every tree".

Examination of specimens of *A. gillettiae* and *A. retinens* revealed that the two consitute a single species, for which the name *A. retinens* takes precedence.

Henkel (1934) regarded *A. gillettiae* as being synonymous with *A. retinens* but this appears to have been overlooked.

SPECIMENS EXAMINED

A. retinens Sim in For. and For. Res. of P.E.A.: 57 (1909); Henkel in Woody Plants of Natal and Zululand: 230 (1934).

Synonym *A. gillettiae* Burtt Davy in Man. Fl. Pl. of Tvl.: 343 (1932). Type: Transvaal, Waterberg Distr., *Galpin M*114 (K, holo.)

MOZAMBIQUE: LOURENCO MARQUES DISTR.: Umbelusi, *Gerstner* 6688 (BOL).

TRANSVAAL: PRETORIA DISTR.: Rooikop, *Smuts* & *Gillett* 2514 (PRE); Bosplaas, 34 miles N. of Pretoria, *Mogg* 14763 (PRE); 12 miles S. of Pienaars River, *Mogg* 16823 (PRE); 32 miles N. of Pretoria, main rd. to Warmbad, *Codd* 826 (PRE). WATERBERG DISTR.: Toowoomba, *Acocks* 8887 (PRE).

SWAZILAND: HLATIKULU DISTR: Ingwavuma Poort, *Compton* 29793 (PRE). STEGI DISTR: Mtindekwa, *Compton* 32059 (PRE).

NATAL: HLABISA DISTR: Hluhluwe, *Ward* 3933 (NH, NU, PRE); 15 miles S. of Mkuze on Hluhluwe rd., *Ross* 1036 (NU). INGWAVUMA DISTR.: Ndumu Game Reserve, *Oatley* 72 (NH); do., W. area, *Ross* 650, 664, 715 (NU); do., southern shore of Nyamiti Pan, *Ross* 671 (NU); between Otoboteni and Ubombo, *McClean H*18481 (NH). NGOTSHE DISTR.: Pongola Settlement, *Gerstner* 2860 (NH); Mkuze Drift, ± 10 miles S. of Magudu on Nongoma rd., *Ross* 1105 (NU); Jozinidam rd., W. slope of Lebombo Mts., *Ross* 1112 (NU). UBOMBO DISTR.: Mkuze, *A. W. Bayer* 599 (NU); do., *Gerstner* 2848 (NH); Mkuze Game Reserve, *Ward* 4008 (NH, NU, PRE); do., *Tinley* 771 (NU); do., *Ross* 306, 1167 (NU); do., *Lawson* 1015 (NU); 3 miles from Mkuze on Nongoma rd., *Ross* 1031 (NU).

A. hereroensis Engl.

Verdoorn (1942), described *Acacia mellei* from the Transvaal and Bechuanaland. Concerning related species Verdoorn (l.c.) noted: "In South-West Africa the species *Acacia hereroensis* approaches it, but in this case the leaflets are smaller than those of *A. mellei*, and also the spines and pods are smaller."

A. mellei has subsequently been recorded from the north east Cape Province and the south west Orange Free State, *A. hereroensis* Engl. being apparently confined to South-West Africa. Examination of specimens, many collected since *A. mellei* was described, revealed the limits of *A. mellei* to be wider than indicated by Verdoorn (l.c.) or by Young (1955). In view of difficulty encountered while attempting to name certain specimens it was necessary to ascertain whether the alleged differences between *A. hereroensis* and *A. mellei* were real.

DISCUSSION

Examination of specimens of *A. hereroensis* and of *A. mellei* revealed that the two species do not differ from one another in flower or in fruit structure. Furthermore, specimens of the two species agree in bark characteristics; in the degree of pubescence of the young branchlets and rachises; in the frequent presence of minute scattered red glands amongst the translucent hairs on the young branchlets and rachises, and of small recurved prickles on the abaxial rachis surfaces; in leaflet size, shape and degree of pubescence.

The differences recorded between the two species are shown in Table 1.

TABLE 1

A synopsis of the differences between *A. hereroensis* Engl. and *A. mellei* Verdoorn

A. hereroensis	*A. mellei*
Prickles up to 7.0 (4.0 ± 2.0) mm. long	Prickles up to 8.0 (5.0 ± 2.0) mm. long
Petiole 0.3–2.2 (1.0 ± 0.4) cm. long	Petiole 0.3–1.4 (0.8 ± 0.3) cm. long
Rachis 1.7–10.0 (4.3 ± 2.2) cm. long	Rachis 2.5–7.5 (4.8 ± 1.7) cm. long
8–26 (15 ± 4) pinna pairs	7–21 (14 ± 4) pinna pairs
Rachilla 0.5–2.6 (1.5 ± 0.6) cm. long	Rachilla 0.8–3.4 (2.1 ± 0.7) cm. long
16–48 (29 ± 9) pinnule pairs	17–37 (28 ± 7) pinnule pairs
Pinnule 1.0–3.3 (2.0 ± 0.9) mm. long, 0.5–1.1 (0.8 ± 0.2) mm. wide	Pinnule 1.3–3.1 (2.2 ± 0.7) mm. long, 0.5–1.1 (0.9 ± 0.2) mm. wide
Flower spikes 2.2–8.6 (4.6 ± 2.0) cm. long	Flower spikes 2.4–6.9 (4.7 ± 1.8) cm. long
Peduncle 0.3–2.0 (1.3 ± 0.5) cm. long	Peduncle 0.4–2.8 (1.3 ± 0.6) cm. long
Calyx subglabrous to densely pubescent	Calyx puberulous to densely pubescent
Pods 6.0–13.6 (9.1 ± 2.7) cm. long, 0.9–2.1 (1.5 ± 0.4) cm. wide	Pods 5.7–13.0 (9.4 ± 2.0) cm. long, 1.2–2.1 (1.6 ± 0.4) cm. wide

Although the prickles of *A. hereroensis* are slightly smaller than those of *A. mellei* it may be seen that the leaflets and pods of the former species are not smaller than those of the latter species as stated by Verdoorn (l.c.), but are sometimes slightly larger than those of *A. mellei*.

The means for each character of *A. hereroensis* intergrade with the means for each corresponding character of *A. mellei* so that no distinction can be drawn between *A. hereroensis* and *A. mellei* on the basis of any one of the above characters. The extreme differences between the two species for each character are best regarded as no more than part of the overall variation pattern.

TAXONOMIC CONCLUSIONS

As no clear distinction can be drawn between *A. mellei* and *A. hereroensis* the two must be regarded as a single species for which the name *A. hereroensis* Engl. takes precedence.

There is a tendency for the young branchlets, rachises and calyces of some of the Transvaal specimens to be slightly more pubescent than some of the South-West African specimens but this does not warrant taxonomic recognition.

SPECIMENS EXAMINED

A. hereroensis Engl. in Engl. Bot. Jahrb. X: 20 (1888): Schinz in Mém. Herb. Boiss. I: 112 (1900); L.T.A.: 835 (1930). Type: S.W.A., KARIBIB DISTR. Otjimbingwe, *Marloth* 1331 (PRE, GRA pro parte, iso.).

Synonym *A. mellei* Verdoorn in Flowering Plants of South Africa: 22: t. 860 (1942); Miller in J.S. Afr. Bot. XVIII: 23 (1952); Young in Candollea 15: 109 (1955).

SOUTH-WEST AFRICA: GOBABIS DISTR.: 53 miles from Windhoek on Gobabis rd., *Liebenberg* 4562 (PRE). GROOTFONTEIN DISTR.: Otavi, *Dinter* 5303 (BOL, PRE); Grootfontein, *Schoenfelder* 236 (PRE); do., *Keet* 1678 (PRE); 3·6 miles from Otavi on rd., to Otjiwarongo, *de Winter* 2850 (PRE). KARIBIB DISTR.: Farm Wilsonfontein, *Hälbich* 1308 (PRE). KEETMANSHOOP DISTR.: Rocky banks of ravines in Great Karasberg Wasserfall, *Pearson* 8072 (GRA, KMG, PRE); Great Karasberg, high plateau between Wasserfall and Krai Kluft, *Pearson* 8267 (BOL); Great Karasberg, Naruda Süd, *Pearson* 8237 (BOL). OKAHANDJA DISTR.: Waldau, *Dinter* 370 (GRA); Teufelsbach, farm Otjiserva, *Wiss and Kinges* 789 (PRE). OTJIWARONGO DISTR.: Waterberg, *Pole Evans H*19314 (PRE); Waterberg plateau, *Boss H*35004 (PRE). REHOBOTH DISTR.: Khomas Highland, *Keet* 1684 (PRE). WINDHOEK DISTR.: between Hoffnungsfelde and Haris, *Pearson* 9548 (BOL); mountains at Windhoek, *Keet* 1691 (PRE); 28 miles from Windhoek, *Liebenberg* 4567 (PRE); Awas Mts., *Boss H*36274 (PRE); 5 miles E. of Windhoek, *Codd* 5801 (PRE); Khomas Highland, Farm Auuanis, *Merxmuller and Giess* 1773 (PRE). PRECISE LOCALITY UNKNOWN: Aob, *Dinter* 5160 (PRE); (illegible station), *Dinter* 4415 (PRE); Omuverume, *Volk* 352 (PRE); farm Binsenheim, *Volk* 2311a (PRE).

CAPE PROVINCE: KURUMAN DISTR.: near Litakoon, *Gerstner* 6299 (PRE). MAFEKING DISTR.: 19 miles from Setlagoli on rd. to Mafeking, *Codd* 1323 (PRE); Mafeking Golf Course, *Miller B*/499 (PRE).

ORANGE FREE STATE: FAURESMITH DISTR.: Fauresmith, Veld Reserve, *Henrici* 4367 (PRE).

BECHUANALAND: SOUTH-EASTERN DISTR.: South of Lobatsi, *Pole Evans* 3152 (2) (PRE); Ramoutsa, *Miller B*/215 (PRE); Pharing, near Kanye, *Miller* B/597 (PRE); do., *Miller* B/718 (PRE).

TRANSVAAL: BRITS DISTR.: Brits, Farm Welgevonden, Peter Kopjie paddock, *Phillips and Mogg* 14647 (GRA, NH, PRE). LICHTENBURG DISTR.: (illegible station) *Verdoorn* 1692 (PRE). MARICO DISTR.: Groot Marico, Veeplaats, *Liebenberg* S.114 (PRE); Lekkerlach, *Louw* 604 (NH, PRE). PRETORIA DISTR.: Farm South of Pretoria *Melle H*29610 (PRE); growing on farm of H. Melle, W. of Sixmiles Spruit, *Verdoorn H*29608 (PRE); Zwartkop, S. of Pretoria, *Melle H*26514 (PRE), (holotype of *A. mellei*); Pretoria, West End, Zeiler St. canal, *Repton* 2743 (PRE). RUSTENBURG DISTR.: Zwartruggens, *Sutton* 908*A* (PRE). VENTERSDORP DISTR.:? Raatsiebay, *Pole Evans* 3127 (PRE); Goedgedacht, *Sutton* 635 (PRE). WATERBERG DISTR.: Warmbaths, Toowoomba, *Penning H*29607 (PRE). PRECISE LOCALITY UNKOWN: 2 miles N. of Oubosdal (label on another specimen reads 2 miles E. of Oubosdal), *Pole Evans* 2211 (PRE).

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ÜBER DIE JAHRESKURVEN DES OSMOTISCHEN WERTES BEI EINIGEN HARTLAUBARTEN DES KAPLANDES.

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Mit 10 Textabbildungen

Summary

The osmotic values and water content were investigated, in *Protea arborea*, *P. neriifolia*, *P. repens* (*mellifera*), *Leucospermum conocarpum*, *L. hypophyllum*, and in two species of the Restionaceae namely; *Elegia stipularis* and *Thamnochortus erectus*, to indicate the effect of summer drought on the water balance of these plants.

The investigation showed the Restionaceae to be hydrolabile, the *Leucospermum* species hydrostabile and the *Protea's* between these two extremes.

In general the water maintenance of the hard-leaved plants of the Western Cape, during the year 1963/64, was good. The highest osmotic value measured was 27 atmospheres.

Das Klima des Kaplandes entspricht demjenigen des Mittelmeergebietes. Vergleicht man jedoch das Klimadiagramm von Kapstadt mit den Klimadiagrammen der Stationen am Mittelmeer, so bemerkt man gewisse Unterschiede. Das Klima von Kapstadt ist maritimer, d.h. die Temperaturkurve ist ausgeglichener und die Sommerdürre hält zwar im Mittel 5 Monate an (November-März), aber die Niederschlagskurve sinkt in keinem Monat bis auf Null. Abb. 1 zeigt das Diagramm von Kapstadt und zum Vergleich von Gibraltar (Jahresniederschlag höher), von Bizerta in Tunesien (Sommer heißer) und von Lissabon (Klima kühler), bei denen 1–2 Monate selbst als Mittel vieler Jahre praktisch regenlos sind. Der Klimatypus ist jedoch bei allen Stationen der gleiche. Auch das Kapland ist ein Winterregengebiet mit mildem Winter und heißem, trockenem Sommer. Ebenso wie im Mittelmeergebiet trägt die Vegetation des Kaplandes Hartlaubcharakter und kann als Macchie bezeichnet werden. In Südafrika wird sie ,,Fynbos" genannt. Floristisch unterscheidet sie sich jedoch sehr stark von der Mittelmeermacchie. Nur die *Erica*-Arten sind beiden Pflanzenformationen gemeinsam. Während aber im Mittelmeergebiet *Erica arborea*, *E. scoparia*, *E. multiflora* und im Westen auch *E. cinerea* verbreitet sind, fehlen diese Arten dem Kaplande; dafür kommen jedoch bis 600 andere *Erica*-Arten vor. Der Artenreichtum ist überhaupt das hervorstechendste Merkmal der Kapflora, die ja von Diels zu einem eigenen Florenreich—der Capensis—gerechnet wird.

Im Gegensatz zu dem öko-physiologisch eingehend untersuchten Mediterrangebiet wurden Studien dieser Art im Kapland noch nicht durchgeführt.

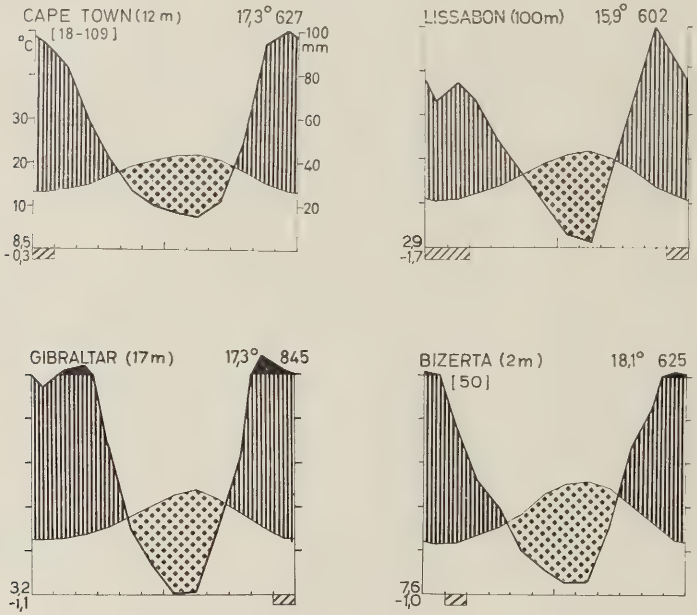

ABB. 1. Klimadiagramm von Kapstadt und zum Vergleich die Klimadiagramme von Lissabon, Gibraltar und Bizerta (Tunesien). Aus Walter-Lieth, Klimadiagramm-Weltatlas, Jena 1960–64.

ERLÄUTERUNG: Oben Name der Station und Höhe über dem Meere in m, in eckigen Klammern Zahl der Beobachtungsjahre (evtl. erste Zahl Temperaturmessungen, zweite Niederschlagsmessungen); rechts oben mittlere Jahrestemperatur in °C und mittlerer Jahresniederschlag in mm.

ABZISSE: Monate (Südhemisphäre Juni—Juli, Nordhemisphäre Januar—Dezember); Ordinate: mittlere Monatstemperatur (Teilstrich = 10°C und dünne Kurve) sowie mittlere monatliche Niederschläge (Teilstrich = 20 mm und dicke Kurve). Humide Jahreszeit schraffiert (T-Kurve unter N-Kurve); bei Niederschlägen über 100 mm im Monat ist der Maßstab auf 1/10 reduziert und die Fläche schwarz. Aride Jahreszeit punktiert (T-Kurve über N-Kurve). Zahlen links unten: obere—mittleres Tagesminimum des kältesten Monats, untere—tiefste gemessene Temperatur (absolutes Minimum). Unter der Abzisse schräg schraffiert—Monate, in denen Frost beobachtet wurde.

Als der erste Verfasser anlässlich der Jubiläumsfeiern des Botanischen Gartens Kirstenbosch im Lenz 1963 das Kapland näher kennen lernte, erschien es ihm deshalb wünschenswert zu sein, zusammen mit dem zweiten Verfasser mit solchen Untersuchungen zu beginnen.

Zunächst sollte bei einigen Vertretern der beiden für die Kapflora besonders charakteristischen Familien, den Proteaceen und Restionaceen, festgestellt werden, wie sich ihre Wasserbilanz während des trockenen heissen Sommers im Vergleich zum regnerischen, kühlen Winter gestaltet. Als Indikator für die Wasserbilanz wurde ähnlich wie bei der im Mittelmeergebiet (Montpellier) durchgeführten Arbeit (Braun-Blanquet u. Walter 1929) der osmotische Wert der Blätter verwendet.

Da eine Bestimmung des osmotischen Wertes im Kapland selbst nicht möglich war, wurde folgende, schon in Australien erprobte Methode angewandt:

Der zweite Verfasser entnahm in monatlichen Abständen oder häufiger die Blattproben, bestimmte sofort das Frischgewicht, trocknete sie dann rasch bei 90°C und ermittelte das Trockengewicht.

Aus diesen Werten wurde der Wassergehalt in % des Trockengewichts berechnet. Außerdem wurden die in Plastikbeuteln gut verpackten, trockenen Proben mit der Post nach Stuttgart-Hohenheim geschickt, hier nochmals nachgetrocknet, um die kleine während des Transports evtl. aufgenommene Wassermenge zu entfernen, dann zerkleinert und durch Zufügen von destilliertem Wasser auf das ursprüngliche Frischgewicht gebracht. Diese angefeuchteten Proben blieben gut verschlossen, unter mehrmaligem Umrühren 48 Stunden bei 75°C stehen, damit alle Bestandteile des Zellsaftes wieder in Lösung gehen konnten.

Nach Abpressen wurde der Gefrierpunkt des Preßsaftes ermittelt und der osmotische Wert in atm für $t = 20°C$ berechnet.

Kontrollversuche mit *Hedera helix*-Proben, von denen man die einen nach Abtöten der Blätter gleich ausgepresst hatte, während die anderen nach der oben beschriebenen Methode behandelt wurden, ergaben, daß die Fehlergrößen selten 1 atm überschreiten.

Es soll jedoch nicht verschwiegen werden, daß neuerdings bei sehr wasserarmen Proben von *Quercus ilex* die Werte der getrockneten Proben einige Male bedeutend tiefer lagen und unbrauchbar waren.

Da bei den Proben aus dem Kapland der Wassergehalt stets über 100% des Trockengewichtes betrug, oft fast 200%, so dürften solche groben Fehler kaum vorkommen.

Der Sicherheit halber wurden jedoch stets 2 Parallelproben bestimmt. Wenn die Unterschiede bei diesen in einzelnen Fällen größer waren, so dürfte der höhere Wert der richtigere sein. Wir geben deshalb stets beide Werte an, verbinden aber durch die Kurve die Mittelwerte. Dort, wo nur ein Wert eingetragen ist, stimmten beide Parallelproben überein. Zusätzlich haben wir noch die Kurven des Wassergehalts eingezeichnet, die im allgemeinen einen gegenläufigen Gang aufweisen. Die Werte des Wassergehalts bei Parallelproben differieren nur wenig; deshalb trugen wir nur die Mittelwerte ein.

Die Kurven der osmotischen Werte, möchten wir nur als erste Orientierung betrachten. Wir hoffen, daß durch diese Arbeit die Anregung gegeben wird, mit entsprechenden Untersuchungen im Kapland selbst zu beginnen.

PROBENENTNAHME

Die Proben wurden an 2 Stellen entnommen (s. Abb. 2):

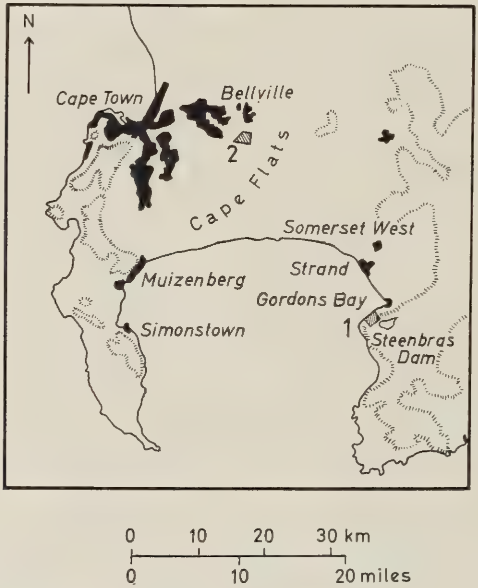

ABB. 2. Lage der Untersuchungsflächen: 1–Gordon's Bay und 2—Cape Flats.

Standort 1—Gordon's Bay. Die Probefläche liegt an einem nach NW exponierten Hang mit 25° Neigung am Fuß der Hottentots Holland Mountains 80–120 m über dem Meere. Der Boden ist durchlässiger sandiger Lehm mit Steinen gemischt über anstehendem Tafelbergsandstein. Der Pflanzenbestand ist etwa 2 m hoch und zeigt eine Deckung von 60 %. In der Strauchschicht dominiert *Protea neriifolia*, daneben sind häufig *Protea arborea*, *Protea repens* (=*mellifera*) und *Leucospermum conocarpum*. In der unteren 80 cm hohen Schicht sind Restionaceen stark vertreten, unter diesen die untersuchte *Elegia stipularis*. Außerdem wurden einige Geophyten notiert. Von allen genannten Arten wurden regelmäßig Proben entnommen.

Die nächst gelegene meteorologische Station ist Somerset West (8 m NN), etwa 5 Meilen nordöstlich von der Probefläche, und Steenbrasdam direkt über der Probefläche in 338 m Höhe über dem Meere.

Standort 2—Cape Flats. Diese Probefläche liegt in der weiten sandigen Ebene, die den Tafelberg von den Bergen weiter im Norden trennt. Sie befindet sich auf dem Gebiet des „University College of the Western Cape", in der Nähe der Ortschaft Bellville. Der Boden ist sandig, das Grundwasser steht im Winter in etwa 5 m Tiefe und im Sommer in etwa 8 m Tiefe.

Auf diesen sandigen Flächen hat sich die aus Australien stammende *Acacia cyanophylla* so ausgebreitet, daß die ursprüngliche Vegetation stark zurückgedrängt wurde. Sie setzt sich aus Restionaceen, Geraniaceen, Liliaceen und anderen Geophyten zusammen. Während der Regenzeit treten viele ephemere Arten auf. Als einzige Proteacee kommt hier *Leucospermum hypophyllum* vor. Untersucht wurde diese Art und die sehr häufige Restionacee *Thamnochortus erectus*, die eine Höhe von 1 m erreicht. Die nächste meteorologische Station ist D. F. Malan-Airport in einer Entfernung von 1 Meile von der Probefläche.

Die ersten Proben wurden am 31.10.63 entnommen, die letzten am 31.10.64.

Über die Temperatur- und Niederschlagsverhältnisse während der Untersuchungsperiode und der vorhergehenden Regenzeit (Juni 1963 bis Ende Oktober 1964) unterrichtet die Abb. 3. Die monatlichen Niederschläge beim

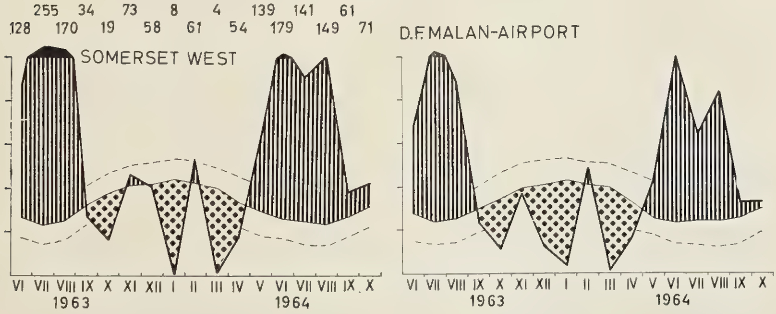

ABB. 3. Klimatogramm (Juni 1963–Oktober 1964) von *Somerset West* und *D. F. Malan-Airport* (schraffiert humide Witterung, punktiert Dürrezeit) mit den mittleren Tagesmaxima (gestrichelt im Sommer) und den mittleren Tagesminima der Temperatur (gestrichelt in Winter). Zahlen oben bei Somerset West sind die monatlichen Niederschläge am Steenbrasdam.

Steenbrasdam sind in Zahlen beigefügt. Sie liegen stets höher als in Somerset West. Diese wiederum höher als beim D. F. Malan-Airport.

Vergleicht man die Regenzeiten (Juni—September) 1963 mit 1964 so erhält man folgende Werte für die Regenmengen:

Regenmenge (Juni-September) in mm	1963	1964
Steenbrasdam	586	529
Somerset West	401	362
D.F. Malan-Airport	301	282

Scheinbar brachte die Regenzeit 1964 einen geringeren Niederschlag, aber dafür war der Mai 1964 sehr feucht. Die Regenmenge betrug in diesem einen Monat in Steenbrasdam 139 mm, in Somerset West 64 mm und beim D.F. Malan-Airport 42,5 mm, während der Mai 1963 sehr trocken war (21,4 mm beim D.F. Malan-Airport).

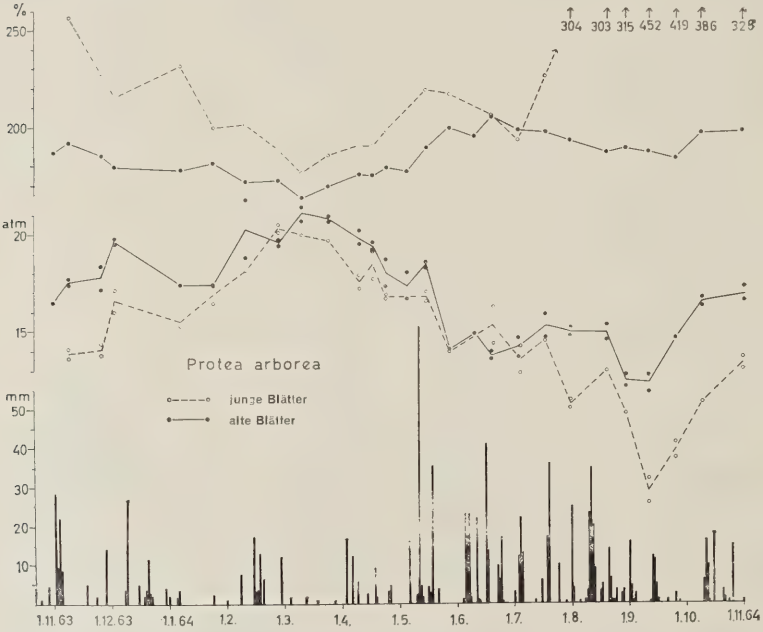

Abb. 4. Kurven des Wassergehalts in % des Trockengewichts (oben) und der osmotischen Werte (unten) von jungen und alten Blättern der *Protea arborea*. Ganz unten die Niederschläge in Somerset West während der Untersuchungszeit.

VERSUCHSERGEBNISSE AM STANDORT 1

(*a*) **Protea arborea:** Abb. 4 zeigt den Verlauf der Jahreskurven des Wassergehalts und des osmotischen Wertes von alten und jungen Blättern der *Protea arborea*, der größten Proteacee des Kaplandes, wenn man von dem Baum *Leucadendron argenteum* absieht, der ein sehr begrenztes natürliches Areal am Osthang des Tafelberges besitzt.

Die osmotischen Werte der jungen Blätter sind im November—Januar stets tiefer als die der alten; in den darauf folgenden Monaten liegen die Differenzen innerhalb der Fehlergrenzen und werden erst nach dem Austreiben im Juli 1964 wieder deutlich.

Die Parallelproben stimmen miteinander gut überein, sowohl bei jungen als auch bei alten Blättern. Nur einmal liegen sie mehr als 2 atm auseinander, in den meisten Fällen dagegen unter 1 atm.

Vergleicht man die Kurve des osmotischen Wertes mit den Regenfällen, die unten eingetragen sind, so erkennt man, daß die Trockenperiode Anfang Dezember 1963 einen scharfen Anstieg bedingt, worauf nach den Regen Mitte und Ende Dezember ein Abfall erfolgt. Die Februarregen bei gleichzeitig hohen Temperaturen wirken sich nicht aus. Die Sommermonate hindurch sind die Werte hoch und fallen erst nach den starken Mai-Regen ab und halten sich dann um 15–16 atm, während die Sommerwerte 20–21 atm betragen. Die Schwankungen sind somit nicht groß.

Die Kurve des Wassergehaltes verläuft ziemlich genau spiegelbildlich. Auffallend ist, daß der Wassergehalt der jungen Blätter den ganzen Sommer hindurch bis kurz vor dem Austreiben im Juli höher ist, als der der alten Blätter. Das dürfte auf eine Anreicherung von nichtlöslichen Aschenbestandteilen in den alten Blättern (evtl. stärkere Verkieselung) zurückzuführen sein, wodurch das Trockengewicht zunimmt, was einen geringeren, auf das Trockengewicht bezogenen Wassergehalt bedingen muß.

Sehr auffallend ist der hohe Wassergehalt der ganz jungen im Frühjahr 1964 (August—Oktober) ausgetriebenen Blätter. Die Werte liegen infolge des geringen Trockengewichts über 300% (bis 450%). Auch der osmotische Wert dieser jungen Blätter sinkt bis auf 7 atm und bei den alten vorübergehend auf 12,5 atm.

(*b*) **Protea neriifolia,** (Abb. 5): Die osmotischen Werte von jungen und alten Blätter unterscheiden sich hier im Frühjahr 1963 und während des Sommers nicht, wohl aber im September—Oktober 1964. Der Wassergehalt ist dagegen nicht nur im Frühjahr 1964, sondern auch 1963 (November—Dezember) viel höher. Merkwürdig ist der fast konstante Wassergehalt der alten Blätter der selbst im Sommer nur wenig sinkt, obgleich die osmotischen Werte von 16–18 atm auf 21–22 atm ansteigen.

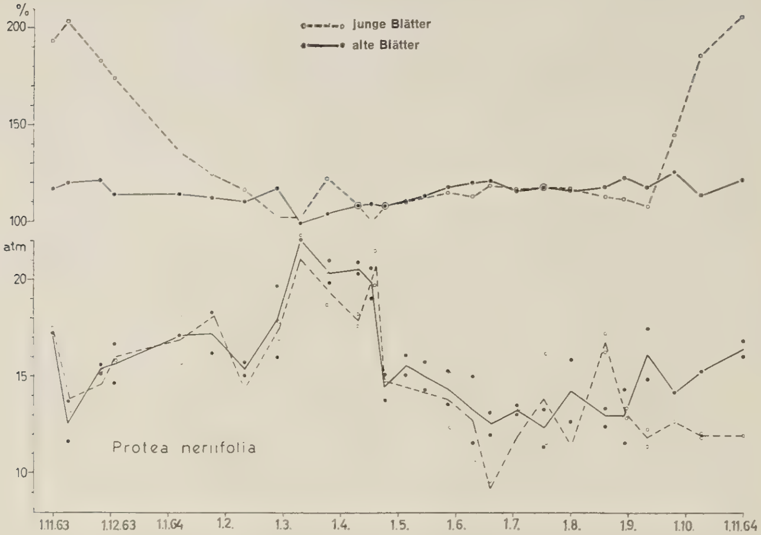

Abb. 5. Dasselbe wie Abb. 4 nur von *Protea neriifolia.*

Das Minimum des osmotischen Wertes im November ist auf die Regen am 2.–5. November zurückzuführen. Das relativ gut gesicherte Minimum im Februar liegt dagegen einige Tage vor den Regen, es sei denn, daß der Regen

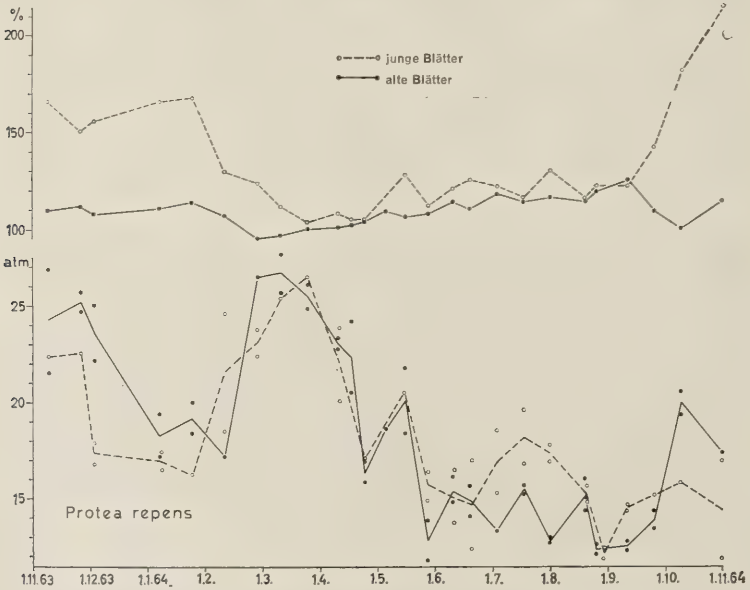

Abb. 6. Dasselbe wie Abb. 4 nur von *Protea repens* (= *mellifera*).

am 8. Februar am Standort der Pflanze stärker war als in Somerset West, was bei Sommergewittern möglich ist. Der eine niedrige Wert den alten Blättern im Juni kann vielleicht eine zufällige Abweichung sein.

(*c*) **Protea repens (= mellifera):** Die Kurven des osmotischen Wertes (Abb. 6) sind sehr unbefriedigend. Das Auspressen des Saftes war schwierig. Die Parallelproben differieren so stark, daß man mit der Auswertung sehr vorsichtig sein muß. Dagegen zeigen die Wassergehaltswerte einen normalen Verlauf.

(*d*) **Leucospermum conocarpum,** (Abb. 7): Diese Art ist sehr hydrostabil. Der osmotische Wert beträgt fast das ganze Jahr 11–14 atm und steigt im Sommer nicht an. Die Parallelproben stimmen gut überein. Auch der Wassergehalt liegt zwischen 220 und 255%. Die Wasserbilanz dieser Art ist somit sehr ausgeglichen. Ob das durch ein gut ausgebildetes, tiefgehendes Wurzelsystem bedingt wird, wurde nicht untersucht.

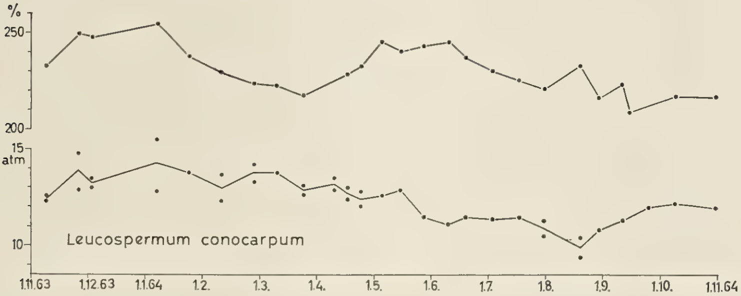

Abb. 7. Wassergehalt (oben) und osmotische Werte (unten) von *Leucospermum conocarpum*.

(*e*) **Elegia stipularis,** (Abb. 8): Während die untersuchten Proteaceen große, lederige Blätter besitzen mit stark verdickter Epidermisaußenwand, aber wenig Sklerenchym, gehören die Restionaceen mehr dem Typus der Rutengewächse an mit reduzierten Blättern. Die Schwankungen des osmotischen Wertes und des Wassergehaltes sind sehr ausgeprägt und verlaufen annähernd spiegelbildlich. Der niedrigste Wassergehalt mit 100% entspricht einem osmotischen Wert von 26,7 atm, der höchste mit fast 220% einem osmotischen Wert von 13,3 atm. Das Produkt (osmotischer Wert × Wassergehalt) also 26,7 × 100 = 2670 und 13,3 × 220 = 2660 ist gleich ein Zeichen, daß die Änderungen des osmotischen Wertes nur durch Unterschiede der Wassersättigung bedingt werden.

Diese Art ist hydrolabil. Die Restionaceen sollen relativ flachwurzelnde Arten sein. Das ist wohl der Grund für die unausgeglichene Wasserbilanz.

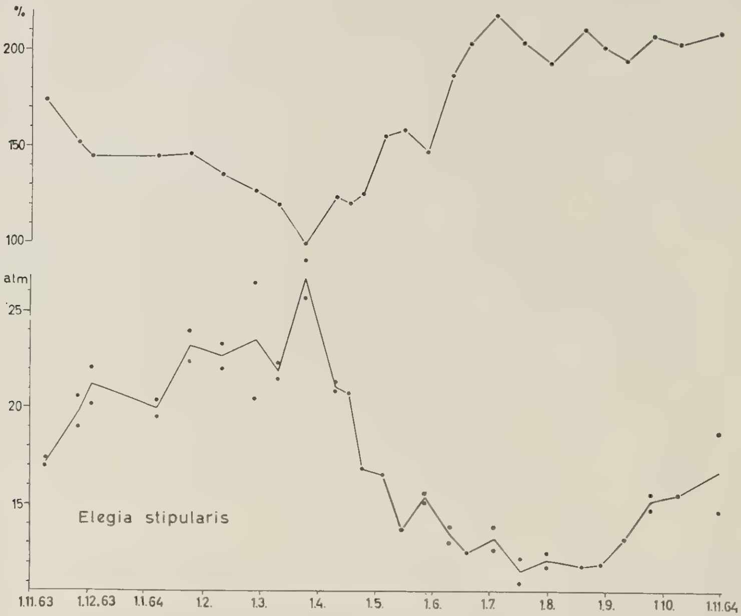

Abb. 8. Wassergehalt (oben) und osmotische Werte (unten) von *Elegia stipularis.*

Versuchsergebnisse am Standort 2

(*a*) **Leucospermum hypophyllum,** (Abb. 9): Diese Art hat ein sehr starkes Wurzelsystem. Sandiger Boden ist für tiefwurzelnde Pflanzen in Trockengebieten immer ein relativ günstiger Standort hinsichtlich der Wasserversorgung. Die oberen Schichten trocknen zwar während der Dürrezeit aus, aber die tieferen behalten die Feuchtigkeit.

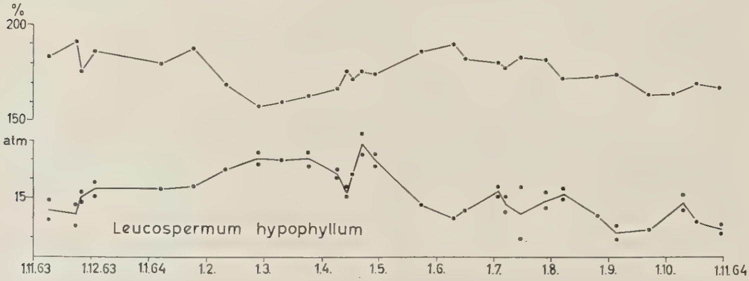

Abb. 9. Dasselbe wie 8 nur von *Leucospermum hypophyllum* (Cape Flats).

Die Wasserbilanz von *L. hypophyllum* ist entsprechend das ganze Jahr hindurch ausgeglichen und die Wassergehaltsschwankungen sind ebenfalls gering. Die Parallelproben stimmen bis auf einen Fall gut überein. Bei der stets guten Wasserversorgung wirken sich die einzelnen Regenfälle kaum aus.

(*b*) **Thamnochortus erectus,** (Abb. 10): Im scharfen Gegensatz zu der obigen Art, weist die Restionacee *Thamnochortus* am selben Standort eine sehr unausgeglichene Wasserbilanz auf. Der osmotische Wert schwankt zwischen 12 atm und 27 atm, der Wassergehalt zwischen 145% und 75%. Das Produkt 1740, bzw. 1745 ist wiederum, wie bei *Elegia* konstant.

Diese Art durchwurzelt den Boden sehr dicht, aber nur bis zu einer Tiefe von 40 cm, so daß die Dürrezeit sich stark auswirkt.

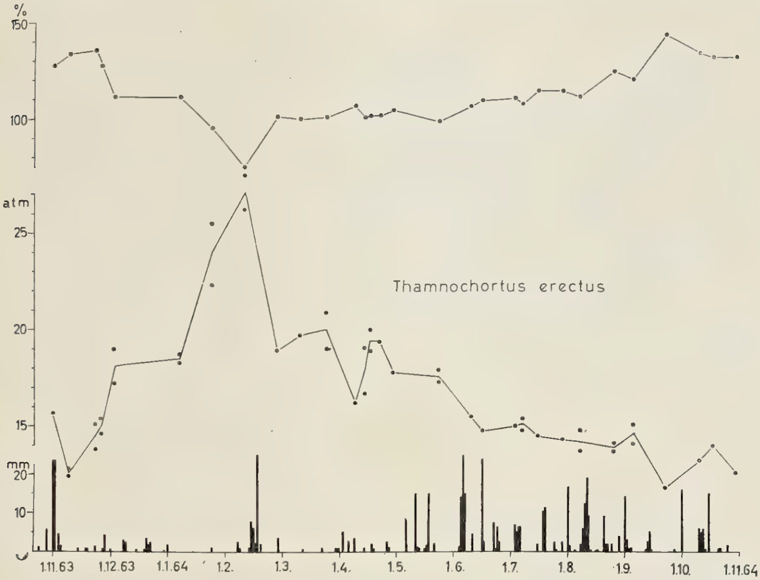

Abb. 10. Dasselbe wie 8 nur von *Thamnochortus erectus* (Cape Flats). Ganz unten Niederschläge während der Untersuchungszeit in D. F. Malan-Airport.

Diskussion der Ergebnisse

Vergleichen wir das Verhalten der verschiedenen Arten miteinander, so können wir hydrostabile Arten, wie die beiden Arten der Gattung *Leucospermum* und hydrolabile, wie die beiden Restionaceen, unterscheiden. Eine gewisse Mittelstellung nehmen die *Protea*-Arten ein.

Bei allen untersuchten Arten sind die osmotischen Werte selbst während der Trockenzeit nicht hoch. Der höchste gemessene Wert überschreitet 27 atm nicht. Im Vergleich zu den Verhältnissen am Mittelmeer ist das nicht viel. Allerdings wurde der Typus der Pflanzen mit weichen, stark behaarten Blättern (Malakophylle), der sich durch besonders starke Schwankungen des osmotischen Wertes auszeichnet, nicht untersucht. Er ist in der Kapvegetation kaum vertreten.

Die Hangschüttböden und der Sandboden der Cape Flats werden während der Winterregenzeit relative viel Wasser aufspeichern, so daß nur die flacher wurzelnden Pflanzen während der Sommerdürre unter etwas erschwerter Wasserversorgung leiden. Der Sommer 1963–64 dürfte kein extrem trockener gewesen sein. In ausgesprochenen Dürrejahren werden die Ausschläge der Kurven vielleicht stärker sein.

ZUSAMMENFASSUNG

Die Jahreskurven des osmotischen Wertes und des Wassergehaltes werden bei den Arten *Protea arborea*, *P. neriifolia*, *P. repens* (*mellifera*), *Leucospermum conocarpum*, *L. hypophyllum* und bei den Restionaceen *Elegia stipularis* sowie *Thamnochortus erectus* untersucht, um eine Vorstellung von der Wasserbilanz dieser Arten während der Sommerdürre zu erhalten.

Die Restionaceen erweisen sich als hydrolabil, die *Leucospermum*-Arten als hydrostabil, die *Protea*-Arten nehmen eine Zwischenstellung ein.

Im allgemeinen war jedoch die Wasserversorgung der Hartlaubarten des Kaplandes während des Sommers 1963–64 gut. Die höchsten gemessenen osmotischen Werte überstiegen 27 atm nicht.

Die Untersuchungen sind nur zur ersten Orientierung über das Problem des Wasserhaushalts der Pflanzen im Kapland auf öko-physiologischer Basis gedacht. Sie sollen zur weiteren Forschung auf diesem Gebiet anregen.

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NOTES ON MESEMBRYANTHEMUM AND ALLIED GENERA

H. M. L. Bolus

Lithops dabneri L. Bol. sp. nov.—Plantae 3 visae, ferae, e corpusculo 1 compositae; corpuscula 3—3·2 cm. longa, 2 cm. lata, ad 2·8 cm. diam., basi rotunda, ad 7 mm. diam., roseo grisea, lobis 1—3 mm. longis, erectis vel in corpusculis florentibus ad per 3 mm. divergentibus, apice crebre verrucoso, verrucis rotundis vel ovalibus vel oblongis, in siccis inter verrucas laete rubris, margine angusto, viride breviterque lacerulato; flores vespertini; pedunculus ad 2·6 cm. longus, in receptaculum insensim transeuns; receptaculum subcompressum; sepala 6, superne leviter angustata, obtusa vel subobtusa, omnia ± anguste marginata, 8—10 mm. longa, basi 3—5 mm. lata; petala 2—3-seriata, inferne levissime angustata, obtusa vel subacuta, aurea, apice, vel rarius dimidio superiore externeque, rubre tincto, 1—1·5 cm. longa, ad 1·5 mm. lata; massa staminum parum supra basim constricta, filamentis ca. 4-seriatis, infra partem constrictam albis, supra luteis, prope basim inconspicue papillatis, ad 7 mm. longis, antheris pollineque aureis; discus inconspicuus crenulatus, vel in flore altero irregulariter crenulatus quasi e glandulis connatis compositus; ovarium supra circa marginem concavum, deinde gradatim altitudinem disci attingens; stylus in flore unico visus, ad 2 mm. longus; stigmata 6, gracillima alba, 7·5 mm. longa; capsula infra subcompresse semiglobosum, crebre 12-costata, costis convexis, 4 mm. longa, ad 11 mm. et 7 mm., expansa ad 1·5 cm., diam., supra per 1 mm. elevata, suturis compressis; pedunculus ad apicem anguste alatus, ad 3 cm. longus.

Cape Province: Griqualand West; "about 35 miles N.W. of Kimberley", *Cecil Potgieter*. N.B.G. 79/65. Fl. Mart.

The following interesting notes relating to this species were made by Mr. C. Potgieter of Kimberley: "These plants grow on a slight incline facing East, the prevailing winds being from the North-West, and the rainfall very sparse—about 3 ins. per annum, the rainy season being March. They are usually found in limestone areas and nearly always under bushes, the bodies being single or very rarely more than two".

Named after Mr. L. Dabneri on whose property it was collected.

Conophytum avenantii L. Bol. sp. nov. (*Euconophytum-Wettsteiniana*).—Plantae plures visi, ad 4 cm. diam.; vagina persistens anni prioris tenuiter pergamentacea, saturate brunnea, superne subpapyracea, atre punctata; corpuscula in circuitu late obovata, ad 1·3 cm. longa, dimidio inferiore 2—3 mm., superiore ampliato, ad 1·4 cm., lato, apice plano vel convexulo, parce inconspicueque saturatiore viridi punctato, ore 1·5—3 mm. longo; pedunculus 4—6 mm. longus, prope basim bracteatus, bracteis herbaceis, apice rotundo, vagina lobis papillatis duplo longiore, 2—3 mm. longis; receptaculum ad 1·5 mm. longum, ad 2 mm. diam.; calyx 5—6 mm. longus, tubo 4 mm. longo, membranaceo, anguste viridi 4—5-nervato, segmentis 5 vel rarius 4, obtusis convexis papillosis, 2—2·5 mm. longis; corolla 2·1—2·4 cm. longa, tubo albo, 1—1·4 cm. longo, segmentis ca. 3-seriatis, obtusis vel obscure emarginatis, pulchre roseis, 1—1·3 cm. longis, ad 1·5 mm. latis; filamenta sat pauca, ca. 6-seriata, e basi tubi adnata, superiora breviter exserta, saepius lutea vel aurea, antheris pollineque aureis; discus sat conpicuus, segmentis truncatis; ovarium supra e disco conice, vel rarius cylindrice, elevatum, altitudinem disci attingens; stylus ad 1·3 cm. longus; stigmata 4—5, 2—3 mm. longa.

Cape Province: Namaqualand; Die Hoop, Richtersveld, *H. Hall* 1299. Fl. Apr. 1965. N.B.G. 95/58.

Named after Mr. Avenant who owned the farm on which it was collected.

Conophytum rooipanense L. Bol. sp. nov. (*Euconophytum*).—Corpuscula obovata, ad 1·3 cm. longa, 1 cm. diam., vel culta obconica, ad 1·5 cm. longa diametroque, viridia, apice convexulo, inconspicue saturatiore viridi punctato, punctis sparsis vel approximatis, praecipue apud extremitates oris; ore leviter depresso, ad 4 mm. longo; flores nocturni; pedunculi 7—9 mm. longi, prope basim bracteati, bracteis herbaceis acutis, prope apicem carinatis, 2—3 mm. longis, vagina lobos subaequante, sinu latissimo; receptaculum subglobosum, 3—4 mm. diam.; calyx herbaceus, 6—8 mm. longus, tubo ad 5 mm. longo, segmentis 5, subobtusis convexulis papillosis, 2—4 mm., vel in flore altero 1—3 mm., longis; corolla 1·2—1·4 cm. longa, tubo pallidissime viridi, 4—5 mm. longo, saepius omnino in tubo calycis incluso, segmentis ca. 4-seriatis, laxis, acutis vel obtusis, pallide citrinis, ad 9 mm. longis, ad 0·75 mm. latis; filamenta ca. 26, e prope medium tubi adnata, ca. 4-seriata, alba, fere omnia breviter exserta, antheris pollineque pallide luteis; discus profunde divisus, segmentis emarginatis; ovarium circa marginem profunde concavum, medio subcylindrice vel subconice elevato, altitudinem disci attingente; stylus brevis vel subnullus; stigmata 5, viridia, fere ad 3 mm. longa; capsula 4 mm., expansa 8 mm., diam., infra obconica, acute 5-angulata, supra obtusissime 5-angulata, margine angusto rugoso, medio ca. 1 mm. elevato, acute 5-angulato, loculis angustissime alatis, seminibus omnibus tamen bene visis; pedunculus latissime alatus.

Cape Province: in dit. Vanrhynsdorp; "on a ridge, on the farm 'Rooipan', at the eastern edge of the Knersvlakte", *P. A. B. van Breda* 1908/63. Fl. Apr. ad Maium 1964 et Apr. 1965.

A form of this species was collected, at the same time as the type, on the farm "Sandvlei" (*P. A. B. van Breda* 1902/63) and, as the flowers of both collections had withered in delayed transit, plants were given to Kirstenbosch, where they flowered in April 1965. The description of the type is based mainly on these.

Conophytum parvimarinum L. Bol. sp. nov. (*Euconophytum-Saxetana*).—Vagina persistens anni prioris papyracea pallida, seniores tenuiter pergamentaceae, brunneae; corpuscula saepius late obovata vel rarius obovata, 6—9 mm. longa, ad 8 mm. diam., basi rotunda, apice elliptico convexulo, ab ore ad marginem interdum obscure carinata, superne breviter molliterque pubescentia, sat pallide viridia, ore linea saturatiore cincto, ± ringente, intus dense pubescente, pilis fere erectis, ad 3 mm. longo; flores per diem noctemque expansi, fragrantes; pedunculi ad 3 mm. longi, basi bracteati; bracteae herbaceae obtusae, intus concavae, dorso rotundo, 2 mm. longae, vagina lobos aequante; receptaculum globosum, ad 3 mm. diam.; calyx herbaceus, fere ad 5 mm. longus, tubo ad 3 mm. longo, segmentis 4, 2 obtusis, 2 angustioribus acutis, inconspicue papillosis, late marginatis; corolla ad 1 cm. longa, tubo albo, 5 mm. longo, segmentis 2-seriatis subaequilongis, obtusissimis, pallide roseis, fere ad 1 mm. latis; filamenta ca. 10, e parum infra medium tubi adnata, alba exserta, antheris fere ad 2 mm. longis, cum polline luteis; discus conspicuus ochraceus; ovarium supra profunde concavum, medio cylindrice elevato, in stylum insensim transeunte; stylus albus, 2 mm. longus; stigmata 4, ad 7 mm. longa.

Cape Province: Namaqualand; Kleinzee, *P. A. B. van Breda* 2054/64. Fl. Mart. 1965. N.B.G. 138/64.

The name refers to the locality of this species, being a translation of Kleinzee or Littlesea in the form of an adjective.

Conophytum largum L. Bol. sp. nov. (*Derenbergia*).—Planta 1 visa, internodiis inclusis; vagina persistens anni prioris aspera rugosa, saturate brunnea, superne atre punctata; corpuscula ad 6 cm. longa, circuitu late obovato, asperula, medio vaginae 1·6 cm. lato, lobis ad 2 cm. longis, basi ad 1·4 cm. latis, pustula sat conspicua, supra visis acutis, lateraliter visis truncatis convexulis, 1·2—2 cm. diam., parte pellucida subquadrata vel subcuneata, carina marginibusque sordide purpureo lineatis, divergio ad 2·5 cm. longo; pedunculus 2·5 cm. longus, bene supra basim bracteatus, bracteis herbaceis acutis carinatis, 9—13 mm. longis, vagina fere duplo longiore quam lobis, sinu angustissimo; receptaculum ad 3 mm. longum, ad 4 mm. diam.; calyx herbaceus, 1·3 cm. longus, tubo 6 mm. longo, segmentis 5—6, linearibus acutis, dorso convexulo, 4—8 mm. longis; corolla 2 cm. longa, tubo superne leviter ampliato, albo, 9 mm. longo, segmentis ca. 3-seriatis, obtusis vel obscure emarginatis, laete luteis, ad 1·25 mm. latis; filamenta ca. 6-seriata, e basi tubi adnata, alba, superiora tantum breviter exserta aureaque; discus inconspicuissimus; ovarii lobi compressi, fere ad 2 mm. conice elevati; stylus 1·5 mm. longus vel subnullus; stigmata 5—6, ad 1·1 cm. longa, stamina bene superantia; capsula 1 visa, sublignescens, infra obconica, tenuiter 12-costata, 5 mm. longa, 8 mm., expansa 1·4 cm., diam., supra obtuse 6-angulata, ad 3 mm. elevata, dimidio superiore valvarum erecto, itaque capsula iterum non omnino clausa.

Cape Province: Namaqualand; prope Steinkopf, *P. A. B. van Breda* 1323. Fl. Veld Reserve, Worcester, Apr. 1965.

The name refers to the large diameter attained by the lobes of the body. Although "the collection was made a long time ago" the plant showed no signs of luxuriant growth.

Lampranthus baylissii L. Bol. sp. nov.—Erectus, diffuse copioseque ramosus, internodiis 2—10 mm. longis, 11 cm., vel culta ad 15 cm., altus; caulis ad 5 mm. diam.; folia ascendentia, interdum subfalcata, supra visa linearia acuta, lat. visa inferne saepe angustata, acuta vel oblique rotundata, viridia, ad 2 cm. longa, 1·5 mm. lata, superne ad 2·5 mm. diam.; flores solitarii; pedunculi 8—10 mm. longi, prope medium bracteati; receptaculum obconicum, 3—4 mm. longum diametroque; sepala 5, omnia ± marginata, fere e basi superne angustata, acuta, interiora apud apicem acute subulata, 4—7 mm. longa, basi 1·5—3 mm. lata; petala 3—4-seriata, interiora pauca, saepius ex infra medium inferne angustata, obtusa vel subacuta, laete lutea, 5—11 mm. longa, 1—2 mm. lata; staminodia nulla; filamenta ca. 4-seriata, epapillata, pallida vel aurea, ad 4 mm. longa, antheris pollineque aurantiacis; ovarii lobi erecti distincti, obtuse compressi, ad 0·75 mm. elevati; stigmata 5, anguste subulata, ad 3 mm. longa cum cauda 1—1·5 mm. longa; capsula infra obconica, acute 5-costata, 6 mm. longa, 6 mm., expansa 1·2 cm., diam., supra per 2 mm. elevata, suturis compressis, valvis ringentibus, carinis distantibus, minute lacerulatis, arista sat longa, apicem valvae attingentibus, alis valvae nunc prope basim tantum adnatis aliterque liberis, nunc ad carinas omnino adnatis.

Cape Province: in dit. Knysna; "Flat Rock, Knysna", *R. D. Bayliss* 1083. Fl. Nov. 1964. N.B.G. 1103/62. "Now 1 ft. in diameter, about 6 inches in height, a *very* showy plant" (*H. Hall*). Sedgefield, Knysna, Nov. 1964, *A. J. Middlemost*. N.B.G. 569/64.—

NOTE.—The measurements given above have nearly all been taken from the wild plant and are less than those in the more luxuriantly grown one.

NOTE.—The type-specimens of all new species described in this paper are in the Bolus Herbarium, University of Cape Town.

(*To be continued*)

STAPELIEAE FROM SOUTH TROPICAL AFRICA, I.

L. C. LEACH

(With Plates XXXVIII—XXXIX)

Caralluma valida N. E. Brown and *C. gossweileri* S. Moore are rather rare and imperfectly known species from southern tropical Africa. As good material has now become available it is thought opportune to publish the following notes with amplified descriptions of both species.

Caralluma valida was first collected by Dr. Emil Holub during one of his journeys through Bechuanaland to the Zambesi River, probably on the last of these, which he made during the years 1875—1877.

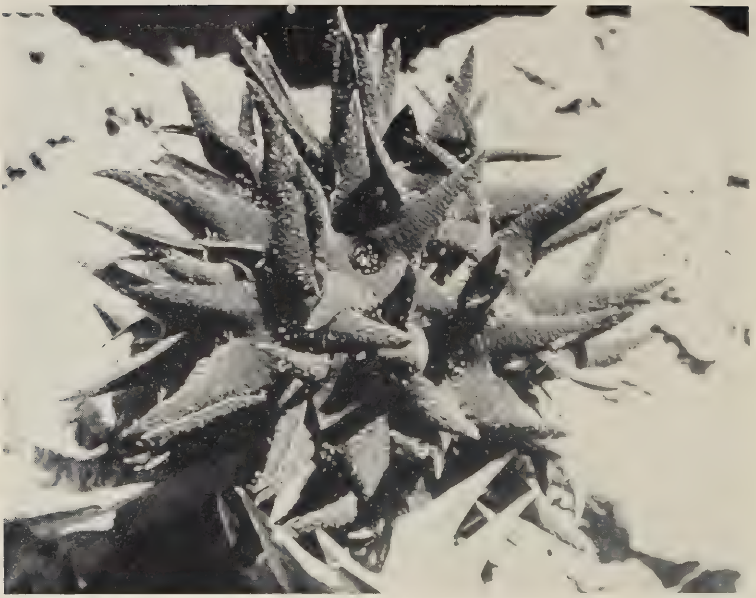
The locality of the type collection is unknown but taking into account the record of his journeys given by Dr. Holub in his *Seven Years in South Africa* (1881) and the localities of the more recent gatherings it seems probable that the original collection was made in northern Bechuanaland or possibly in western S. Rhodesia.

The species then seems to have remained uncollected until about 1937; the plant cultivated in Dr. Louis Thompson's garden at Messina, N. Transvaal, flowered in March 1938 and a specimen is preserved at PRE; it is unfortunate that this excellent material is also of uncertain origin, the locality being given on the label as "? Messina". No further collections appear to have been made until about 1950. From then on records have accumulated quite steadily.

Despite its wide range of distribution *C. valida* remains a rare species, most, if not all recent gatherings have been of one plant only, despite in some cases at least, most diligent searching of the vicinity for further specimens; the distribution range would be considerably extended if Dr. Thompson's plant was in fact collected in the Transvaal, but as he discovered *Stapelia tarantuloides* R. A. Dyer in the southern Matopo Hills at some time prior to 1938, a living plant of *C. valida* may well have been collected on the same excursion.

Caralluma valida N. E. Brown in Kew Bull. 1895; 264 (1895).—in Th. Dyer, F.T.A. **4**, 2: 486 (1902).—A. Berger, Stapelieen und Kleinien: 89 (1910).—White & Sloane, The Stapelieae **1**: 382 (1937).—Jacobsen, Handbook Succ. Pl. **1**: 257 (1960).—Type: ? Bechuanaland, *E. Holub*, s.n. (K. holotype).

Plant a succulent dwarf herb with decumbent stems, ascending towards the apex, rooting where touching the soil. *Stems* stout, 4-angled, usually less than 10 cm. long (rarely up to c. 50 cm.), c. 1.5 cm. thick excluding the teeth, green marbled with purple; teeth stout spreading deltoid acute, up to 1.5 cm. long,



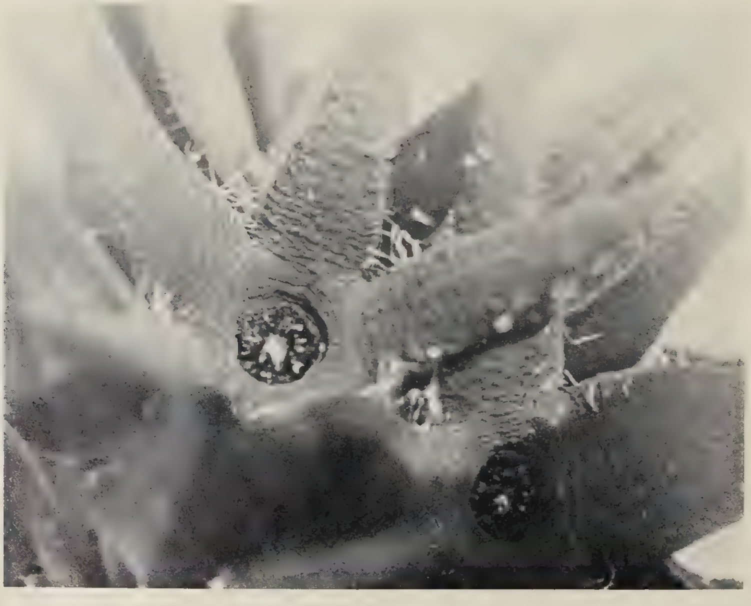


PLATE XXXVIII
Caralluma valida N. E. Brown.
Plant from Lupane District, S. Rhodesia, flowering at Greendale, Dec. 1960, *L. C. Leach* 5811.

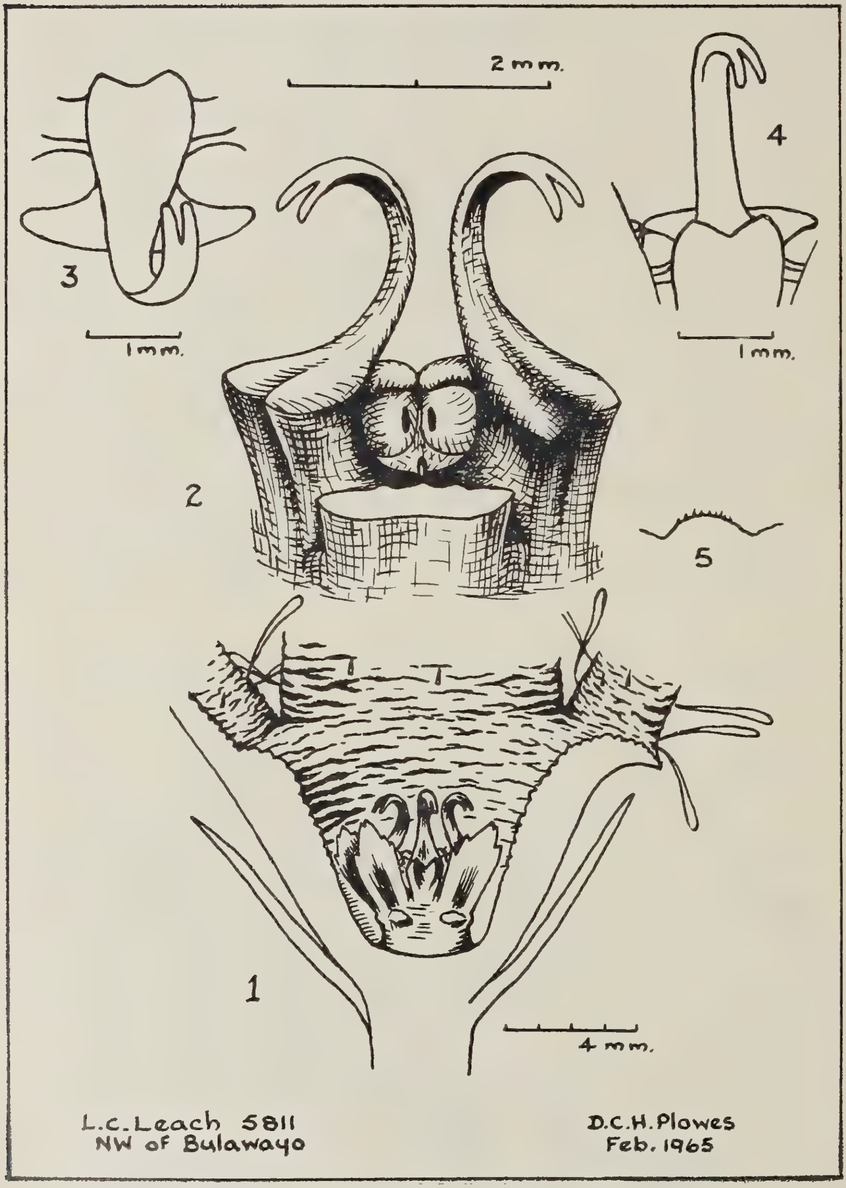
c. 0.5 cm. wide at the base, bearing a pair of minute denticles about 5 mm. below the apex. *Inflorescence* a densely flowered fascicle (sometimes 2 or 3 together) borne on very short stout peduncles, produced from the younger stems, generally from near the base. *Bracts* numerous, fleshy, attenuate, up to 7 mm. long, 2 mm. wide, usually with two or more fleshy subulate teeth up to 2 mm. long, at the sides at or near the base. *Pedicels* terete, 10—15 mm. long, 3 mm. diam., glabrous. *Sepals* 8—9 mm. long, attenuate or narrowly ovate acuminate with spreading or somewhat recurved tips, fleshy, obtuse beneath, glabrous, with a minute fleshy tooth in the sinuses. *Flowers* 20—40, opening more or less simultaneously, exceedingly malodorous. *Corolla* deeply 5-lobed with a short campanulate tube, glabrous outside, microscopically puberulous within, sometimes with a few scattered short stiff hairs up to 0.4 mm. long; tube c. 7 mm. long to the abruptly spreading limb, 10—12 mm. diam. at the mouth; lobes spreading 15—25 mm. long, 5—9 mm. wide at the base, gradually tapering towards the acute apex, heavily rugose on the slightly convex inner surface; margins slightly revolute, densely ciliate with vibratile clavate hairs up to 3 mm. long; there is a very short (prominent in bud) obtuse fleshy tooth in the sinuses of the lobes. *Corona* c. 5.5 mm. diam., c. 3.5 mm. high, slightly raised above the base of the tube, with a transverse gibbosity at the base of the outer lobes, glabrous; outer corona lobes slightly spreading or suberect, thick and fleshy with several rather irregular keels down the inner face, oblong acute or somewhat truncate, dentate, c. 3.5 mm. long, 1.75 mm. wide, shortly adnate at the base to the inner corona lobes, the free portion c. 2 mm. long; inner corona lobes very thick and fleshy at the erect base with a pair of prominent dorsal gibbosities, sharply tapering into the flattened strap shaped apical portion, shortly incumbent on the anthers, erect, recurved at the apex, the apical portion is very variable, sometimes subterete obtuse simple, sometimes only very shortly bifid, sometimes bifid for half its length, all three forms occasionally being found in one corona.

The colour of the flowers is given variously as: deep chocolate (Codd), deep purple maroon (Plowes), deep blood-red (White) and dark purple, almost black (Leach) but all seem agreed on the conspicuousness of the paler coloured vibratile cilia.

? BECHUANALAND. Without locality, ? 1875—1877, *E. Holub* s.n. (K, Holotype)

SOUTH AFRICA. Transvaal: ? Messina, cult. Messina, fl. March 1938, *L. Thompson* s.n. (PRE).

S. RHODESIA. Matobo Distr.: Matopos Research Station, *Acacia* savanna, alt. c. 4,500′, cult. fl. 1951, *D. C. H. Plowes* 2454 (K; LISC); Lupane Distr.: Bembesi Riv., ± 82 miles NW of Bulawayo, *Colophosperum mopane* coppice,



Caralluma valida N. E. Brown

1	Section of corolla.
2, 3 and 4	Inner corona.
5	Puberulous rugosity.

cult. Greendale, fl. Dec. 1960 *L. C. Leach* 5811 (K; PRE; SRGH); ibid., *Mopane* scrub on Kalahari sand, fl. Feb. 1965, *L. C. Walter* 10 (SRGH).

ZAMBIA. Barotseland: Shangambo (Siwelewele), cult. PRE, fl. 8.i.1953, *L. E. Codd* 7485 (PRE); Mazabuka Distr.: Siamambo Forest Res., Karroo mud-stone area, "almost the only associate of *Colophospermum mopane*, on site of old termite mound", fl. 27.xi.1960, *F. White* 7420 (FHO; SRGH); Livingstone Distr.: mixed woodland on Kalahari/Karroo sand, cult. Livingstone, fl. Jan. 1964, Dec. 1964 and Jan. 1965, *W. R. Bainbridge* 1017 (FHO; NDO; PRE; SRGH).

Caralluma gossweileri appears to be an extremely rare species and its collection in S. Rhodesia by Mr. D. C. H. Plowes, some 400—500 miles from the type locality (believed to be the only other known locality) is most interesting.

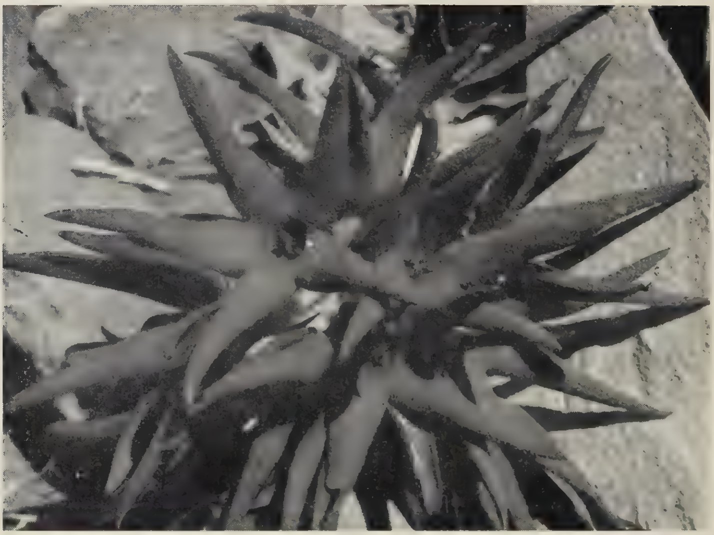
Plowes' plant differs from Gossweiler's in several characters (tabulated below) but in view of the extraordinary variability encountered among other members of this group of the genus, particularly in the shape and width of the corolla lobes, it is considered that these differences are probably not of specific significance; the considerable difference in the width of the corolla lobes could also in part be accounted for by the greater degree of lateral shrinkage, as compared with longitudinal, which occurs when flowers are dried.

	Gossweiler 2098	*Plowes* 1884
	(dried material)	(spirit material)
Stems	4.5 cm. l.	normally up to 10 cm. l.
Stem teeth	1.3 cm. high	2 cm. high
Bracts	3 mm. l.	up to 8 mm. l.
Pedicels	15—20 mm. l.	35—45 mm. l.
Sepals	5.5 mm. l. × 3.5 mm. w.	8—9 mm. l. × 3 mm. w.
Corolla lobes	± 40 mm. l. × 3 mm. w.	± 45 mm. l. × 12.5 mm. w.
Inner corona lobes	slightly gibbous with strongly recurved apices.	scarcely gibbous with the apices only slightly diverging.

Caralluma gossweileri is closely related to *C. valida* but is readily distinguished by its very much larger flowers which are borne on much longer pedicels in fascicles of 6—15 flowers and by the complete absence of the ciliation of vibratile clavate hairs which is so characteristic of *C. valida*, while the distinctive inner corona has the lobes gracefully curved in the shape of a coronet.

Caralluma gossweileri S. Moore in Journ. Bot. 50: 367 (1912).—White & Sloane, The Stapelieae **1**: 346 (1937).—Type: Angola, Kubango, *Gossweiler* 2098 (BM; COI; K!).

Plant a succulent dwarf herb with stout somewhat decumbent stems. *Stems* glabrous, glaucous green lighly marbled with purple, 4-angled, up to 10 cm.



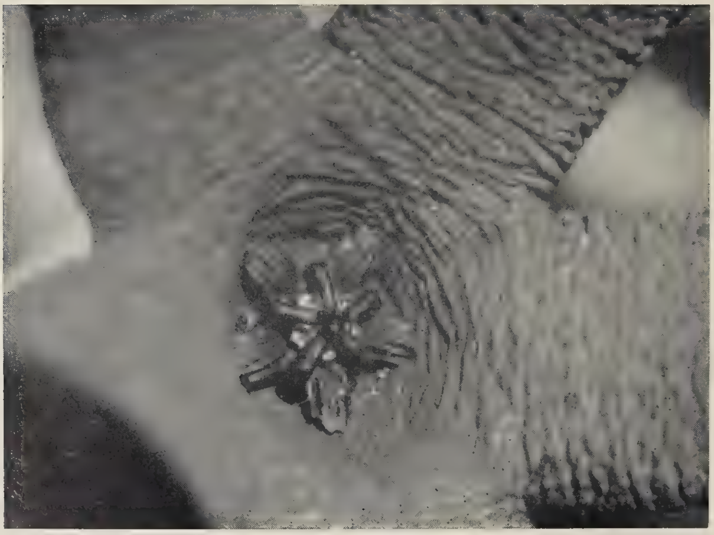


PLATE XXXIX
Caralluma gossweileri S. Moore.
Plant from Nyamandhlovu District, S. Rhodesia, flowering in cultivation, Nov. 1953
D. C. H. Plowes 1884. *Photo: Mr. D. C. H. Plowes*

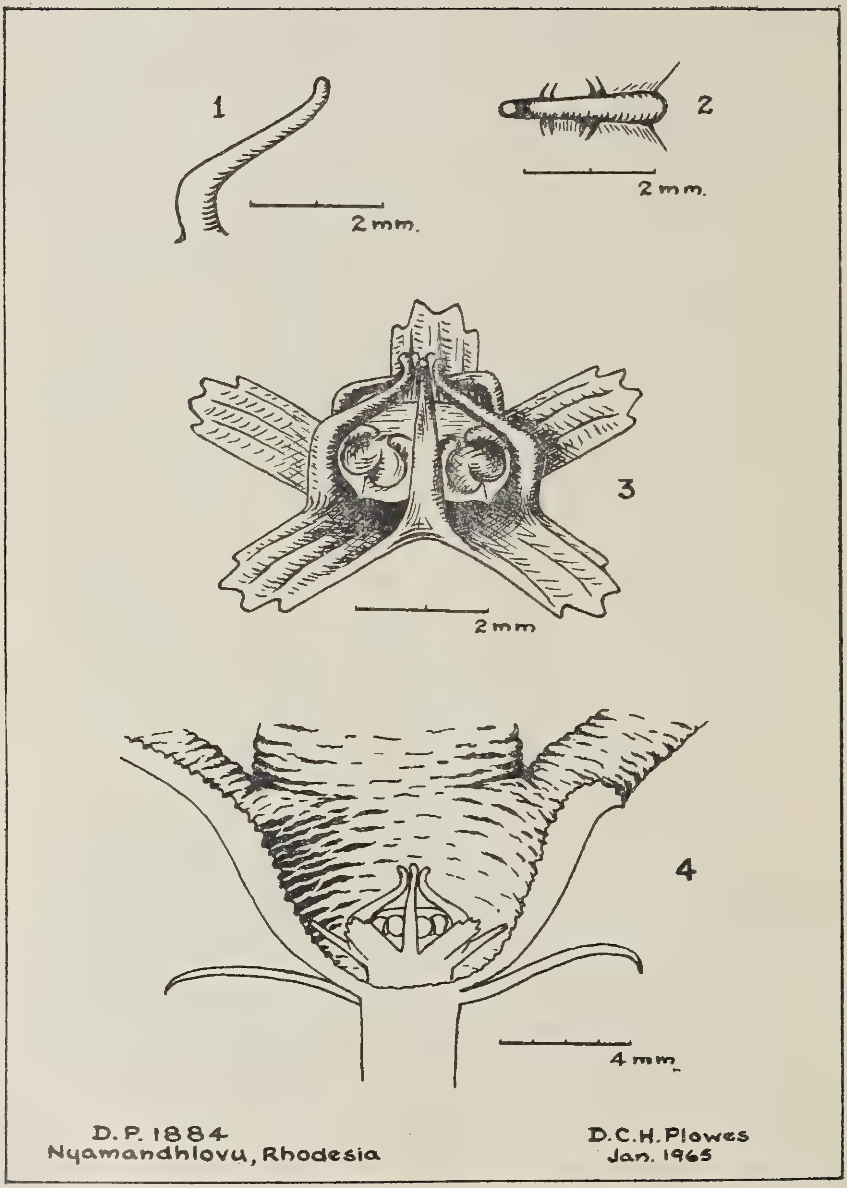
long, c. 1.5 cm. diam. excluding the teeth, somewhat sharply sulcate between the obtuse angles, with stout conical acute spreading teeth; teeth up to 2 cm. long, c. .75 cm. thick at the base, with a minute denticle on each side ± 5 mm. from the apex, sometimes with a minute fleshy axillary tooth. *Inflorescence* a shortly stoutly pedunculate fascicle (sometimes 2 together) of 6—15 flowers, produced from near the base of the young stems. *Bracts* numerous, glabrous, fleshy, attenuate, up to 8 mm. long, 2 mm. wide, with one or two spreading subulate fleshy teeth up to 1 mm. long on each side at or near the base. *Pedicels* terete, 3.5—4.5 cm. long, c. 3.5 mm. diam., glabrous, pale green. *Sepals* glabrous, 5.5—9 mm. long, c. 3 mm. wide, narrowly ovate acuminate with a minute fleshy tooth in the sinuses. *Flowers* opening simultaneously, "brownish maroon" (Plowes) evil smelling. *Corolla* deeply 5-lobed, with a short campanulate tube, glabrous outside, sometimes slightly microscopically puberulous within, transversely rugose towards the base of the lobes (sometimes almost to the base of the tube) becoming coarsely granular with longitudinal fissures towards the apex; tube c. 7 mm. long, 8—12 mm. diam. at the mouth; lobes spreading, up to 4.5 cm. long, 3 mm. (dried)—12.5 mm. wide at the base, attenuate, the inner surface somewhat convex with slightly revolute margins, entirely without cilia; there is a very short obtuse tooth in the sinuses. *Corona* glabrous, dark shining maroon, ± 8 mm. diam., slightly raised above the base of the tube; the outer lobes spreading from the shallow rim-like base, oblong, c. 2.5 mm. long, 1.5 mm. wide, with the apex 4-dentate, 3 keeled on the upper convex surface, somewhat concave beneath; the inner lobes shortly adnate to the outer at their base, c. 3.5 mm. long, sometimes slightly gibbous, subterete, gradually tapering towards the obtuse tips, very shortly erect at first then incurved, closely incumbent on the anthers, connivent, shortly divergent or recurved at the apex.

ANGOLA. Kubango: Forte Princeza Amelia, *Gossweiler* 2098 (BM; COI; K!).

S. RHODESIA: Nyamandhlovu Distr., Pasture Research Station, on Kalahari sand in *Baikiaea—Terminalia—Burkea* association, alt. c. 4,000′, cult. Nyamandhlovu, fl. Nov. 1953, *D. C. H. Plowes* 1884 (K; PRE; SRGH).

Gossweiler 12612 (LISC) and *R. Santos* 119a (LISC), both from Huila, Angola, are closely related to *C. gossweileri* but both have cilia of long clavate vibratile hairs; the locality would seem to indicate *C. huillensis* Hiern as the more likely identity but both plants differ in some respects from the description of that species and further investigation is needed before these specimens can be identified with certainty.

The taxonomic problems posed by this group (which also includes *C. lutea* N.E. Brown and the var. *lateritia* (N.E.Br.) Nel, *C. vansonii* Bremek. & Oberm., *C. nebrownii* Berger etc.) are most intriguing; almost every individual appears to



Caralluma gossweileri S. Moore

1 and 2 Inner corona lobe.
3 Corona.
4 Section of corolla.

be different and yet an extremely close relationship is clearly evident. It is the writer's opinion that these problems will not satisfactorily be resolved until adequate quantities of material become available for investigation. It is partly in the hope that some stimulation of collecting in this most interesting field may result that this paper is now published.

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Mr. D. C. H. Plowes for the drawings illustrating this article and for the photographs of *C. gossweileri;* for many living plants and much information regarding the *Stapelieae* of the Bulawayo and Nyamandhlovu Districts of S. Rhodesia.

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SOUTH AFRICA

Kirstenbosch, Newlands, Cape Province

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DIRECTOR OF THE NATIONAL BOTANIC GARDENS OF SOUTH AFRICA
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The National Botanic Gardens were established in 1913 by unanimous resolution of the Parliament of the Union of South Africa; Kirstenbosch, part of the Groote Schuur Estate at Cape Town bequeathed to the nation by Cecil Rhodes, being chosen as the site and reserved by the Union Government for this purpose.

The Upper Kirstenbosch Nature Reserve, Table Mountain, was placed under the same control in 1922 for the better protection of the native vegetation.

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EUPHORBIA SPECIES FROM THE FLORA ZAMBESIACA AREA: IV

L. C. Leach

(With Plate XL)

Euphorbia persistentifolia Leach, sp. nov.

Euphorbia sp. "A", White, Dyer & Sloane, The Succulent Euphorbieae, **2:** 978 (1941).—E. sp. "C", White, Dyer & Sloane, tom. cit.: 980 (1941).—*Euphorbia memorosa** sensu Jacobsen, Handbook Succ. Pl. **1:** 451 (1960), pro parte quoad distrib. Wankie.

E. heterochromae Pax affinis sed crassiore habitu, caule medio crasso, marginibus corneis semper continuis, foliis maxime grandioribus subpersistentibus, capsula grandiore truncata, semine majore laevi; *E. graniticolae* Leach affinis sed ramis ramosis segmentis longioribus angulis paucioribus, foliis grandioribus subpersistentibus, inflorescentia unicymosa, involucro capsula et semine omnino multo majoribus differt.

Arbuscula crassa succulenta spinosa c. 2 m. alta (usque ad 3·5 m.), caule medio crasso angulato spinoso (rariter trunco cylindrico nudo), ramis ascendentibus erectis plus minusve verticillatis; rami secundarii et ramuli verticillati ex marginibus ad basem segmentorum producti. *Rami* crassi, 2—5 cm. diam., in segmenta constricti; segmenta usque ad 40 cm. longa, faciebus lateralibus subparallelis planis aliquantum concavis vel sulcatis, 4—5-angulati, plerumque 4, angulis plus minusve aequis (saepe sinuato-tuberculatis), margine continuo, corneo conspicuo, spinis binis rectis (raro uncinatis) divergentibus 3—7 mm. (15 mm.) longis armato. *Folia* anguste elliptica vel

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*An error for *Euphorbia memoralis*.

anguste obovata acuta subcarnosa, ad 6 (10) cm. longa, ad 1·6 (2·5) cm. lata subpersistentia ad basem spinulis binis instructa. *Inflorescentia* unicymosa, breviter pedunculata, 4—6 mm. supra spinas producta, cyathiis 3 horizontaliter dispositis. *Pedunculus* bibracteatus ad 3 mm. longus; bracteae depresse ovatae truncatae, irregulariter dentatae; cyathium medium plerumque masculinum deciduum interdum bisexuale; cyathia lateralia bisexualia, ramis cymae ad 3 mm. longis; bracteae plus minusve ovatae irregulariter denticulatae. *Involucrum* infundibuliforme 5—6 mm. diam., 3·5—4 mm. longum, lobis 5 erectis transverse late ellipticis fimbriatis; glandulae 5 transverse oblongo-ellipticae 2—3 mm. latae, leviter foveolatae concavae vel planae suberectae interdum patulae. *Flores masculi* 20—25 (ad 45), 5-fasciculati bracteolis fimbriis filiformibus; bracteae fasciculares fimbriatae laciniatae. *Ovarium* pedicello curvato mox exsertum; styli c. 2·5 mm. longi, plerumque in columnam breviter connati, patuli reflexique, apicibus bifidis rugulosis. *Capsula* 3-lobata interdum 4, truncata 5·5—7 mm. diam., 3—4 mm. longa, pedicello ad 7 mm. longo, perianthio irregulariter deltato. *Semen* subglobosum c. 2·5 mm. × 2 mm. laeve vel perleviter pustulatum flavo-brunneum.

Type: *L. C. Leach* 9383 (BM; G; K; PRE; SRGH, holotype).

S. RHODESIA. Selukwe Distr.: Bonsor Mine, steep rocky slope, alt. 3,900′, cult. PRE, fl. & fr. Nov. 1942, lvs. Feb. 1943, *Carruthers-Smith* in Nat. Herb. 28440/41/42 (PRE; SRGH); Sebungwe Distr.: Zambesi Valley "inaccessible part" fl. 10.ix.1949, *O. West* 2920 (PRE); "sandstone hills near Binja's Kraal", fl. Sept. 1955, *R. M. Davies* in SRGH 55360 (SRGH). Wankie Distr.: Wankie, cult. Selukwe, st. Sept. 1942, R. H. R. Stevenson in Nat. Herb. 28439 (PRE); 10 m. S of Wankie, alt. 3,200′, st. 14.vii.1952, L. E. Codd 7073 (PRE); Lukosi Riv., fl. & fr. 1956, *D. C. Plowes* 1903 (PRE; SRGH); Deka Riv., alt. c. 2,300′, cult. Greendale, fl. Oct. 1961, *Leach* 5194 (K); Inyantui Riv., near Inyantue Pens, c. 2,750′ alt., lvs. 29.iii.1963, *Leach* 11629 (BM; K; PRE; SRGH). Sipolilo Distr.: 28 m. N of Sipolilo, Zambesi Escarp., alt. 3,000′, plants with nude cylindric trunks, up to 9′ high, lvs. 17.iv.1960, *Leach & Brunton* 9867 (K; PRE; SRGH).

ZAMBIA. Mazabuka Distr.: Chirundu, Zambesi Riv. banks, approx. 16° 1′ S, 28° 47′ E, fl. & fr. 20.ix.1959, cult. Greendale, lvs. June 1964, *Leach* 9383 (BM; G; K; PRE; SRGH); ± 22 m. WNW of Chirundu, cult. Greendale, lvs. 27.ii.1960, fl. Oct. 1961, *Leach* 9784 (K; LISC; PRE; SRGH); ·5 m. W of Chirundu, lvs. 28.ii.1960, *Leach* 9810 (PRE; SRGH); ± 20 m. WNW of Chirundu, cult. Greendale, lvs. June 1961, A. S. Boughey in Leach 9641 (SRGH), idem, fl. Oct. 1961, (BM); Kafue Gorge, cult. Greendale, lvs. June 1961, *R. B. Drummond* 6746 (SRGH); 3 m. SW of Kafue, plants with cylindric nude

trunks to 10′ high, cult. Greendale, lvs. June, 1961, *Leach* 9803 (PRE; SRGH); ± 18 m. WNW of Chirundu, cult. Greendale, fl. & fr. Nov. 1961, *T. Brunton* in *Leach* 9506 (BM; G; K; LISC; PRE; SRGH).

L. Vereker s.n. (PRE), "Victoria Falls, up to 24″ high" and *D. C. Plowes* 1895 (PRE), "basalt gorge below Victoria Falls", appear both to belong here but identification is uncertain as the specimens are sterile; the author, unfortunately, has not seen this particular community.

E. persistentifolia is one of a numerous group of closely related taxa which includes such diverse species as *E. heterochroma* Pax, *E. griseola* Pax, *E. memoralis* R. A. Dyer and *E. graniticola* Leach; it differs from all these in a number of characters as well as in the much larger size and more persistent nature of its leaves by which it may be immediately distinguished.

It seems that the new species has its closest affinity with *E. heterochroma* but in habit and vegetative characters it is very different indeed while its inflorescence is more markedly pedunculate, has a differently shaped involucre with the glands generally suberect and distinctly separate, more numerous male flowers and longer bifid styles, the capsule is also larger and more truncate and the seed is smooth or very obscurely pustulate (the seed of *E. heterochroma* is verrucose); it is interesting to note that the seeds of *E. persistentifolia* are also sometimes somewhat verrucose when immature.

In habit the closest relationship is perhaps with *E. graniticola* but the branches of *E. persistentifolia* are rather more frequently rebranched, very much less or not at all winged and have much longer segments with fewer angles; the subpersistent leaves are very much larger and an entirely different shape from those of *E. graniticola*; finally the new species is a very much faster growing plant with the respective juveniles shewing marked differences.

The distribution, as at present known, is generally along the Zambesi Valley from below the Victoria Falls to a little below the Zambesi/Kafue confluence; populations along the various tributaries are not extensive except in the case of the Kafue River, where plants are known to occur at least as far upstream as Kafue. There is also a strangely disjunct community near Selukwe some 400 miles to the south of the main distribution.

E. persistentifolia is an extremely variable species; plants from the Wankie area have rather smaller more fleshy leaves than the Chirundu specimens and the capsules tend to be less truncate; in habit the Wankie plants resemble *E. graniticola* more closely than do those from lower down the Zambesi Valley, while those inhabiting the southern escarpment, near Sipolilo in S. Rhodesia, usually adopt a more tree-like habit.

The greatest range of variability occurs in the Chirundu/Kafue area where individuals may have the typical, stout, erect arbusculent habit: be much reduced in height, divaricately branched and rebranched: or less frequently, become small trees with stout cylindric nude trunks; specimens may be strongly armed to almost unarmed. It is also in this area that the tendency to produce bisexual primary cyathia and 4-locular capsules is most marked (a tendency continued in cultivation); the number of male flowers varies from 20 to 45 and the fascicular bracts are occasionally absent.

The Selukwe community is reported as growing on a steep rocky slope in shade; plants are consequently rather straggling; it was at one time thought that these might be outlying specimens of *E. memoralis*, which species is endemic on the serpentine dyke much further north in the Mtoroshanga/Horseshoe Block area, but although related, these plants are quite distinct. It seems probable that this population will be found to extend along the hills of the dyke to the south of Selukwe as the author has seen a plant in Mr. Auret's garden; this is reported by him as having been collected on his "Mount Belingwe Farm" which lies immediately to the south of Mt. Emberengwa (approx. 70 miles south of Selukwe).

Plant a spiny succulent stout shrub or small tree, usually a shrub c. 2 m. high, with a stout, angled central stem and ascending erect whorled branches, sometimes a shrub c. 1 m. high with divaricately branched and rebranched spreading branches, or more rarely, a small tree up to c. 3·5 m. high with a stout cylindric trunk and a crown of spreading branches. *Branches* stout, 2—5 cm. diam., 4—5 angled (usually 4), with the sides flat or concave, seldom sufficiently so as to be described as winged, constricted into long segments up to 40 cm. long with the sides almost parallel, very slightly tapering upwards, generally somewhat sparingly branched and rebranched, more or less whorled from shortly above the constrictions; the angles sinuate-tuberculate, often not very prominently so, sometimes almost even, with a conspicuous whitish horny margin, armed with a pair of straight (rarely curved) diverging spines, 3—7 (15) mm. long at the apex of the tubercles, 10—20 mm. apart along the angles, with a pair of prickles at the leaf base. *Leaves* narrowly elliptic to narrowly obovate, acute, subfleshy, up to 10 cm. long, 2·5 cm. wide, generally c. 6 cm. × 1·6 cm.,

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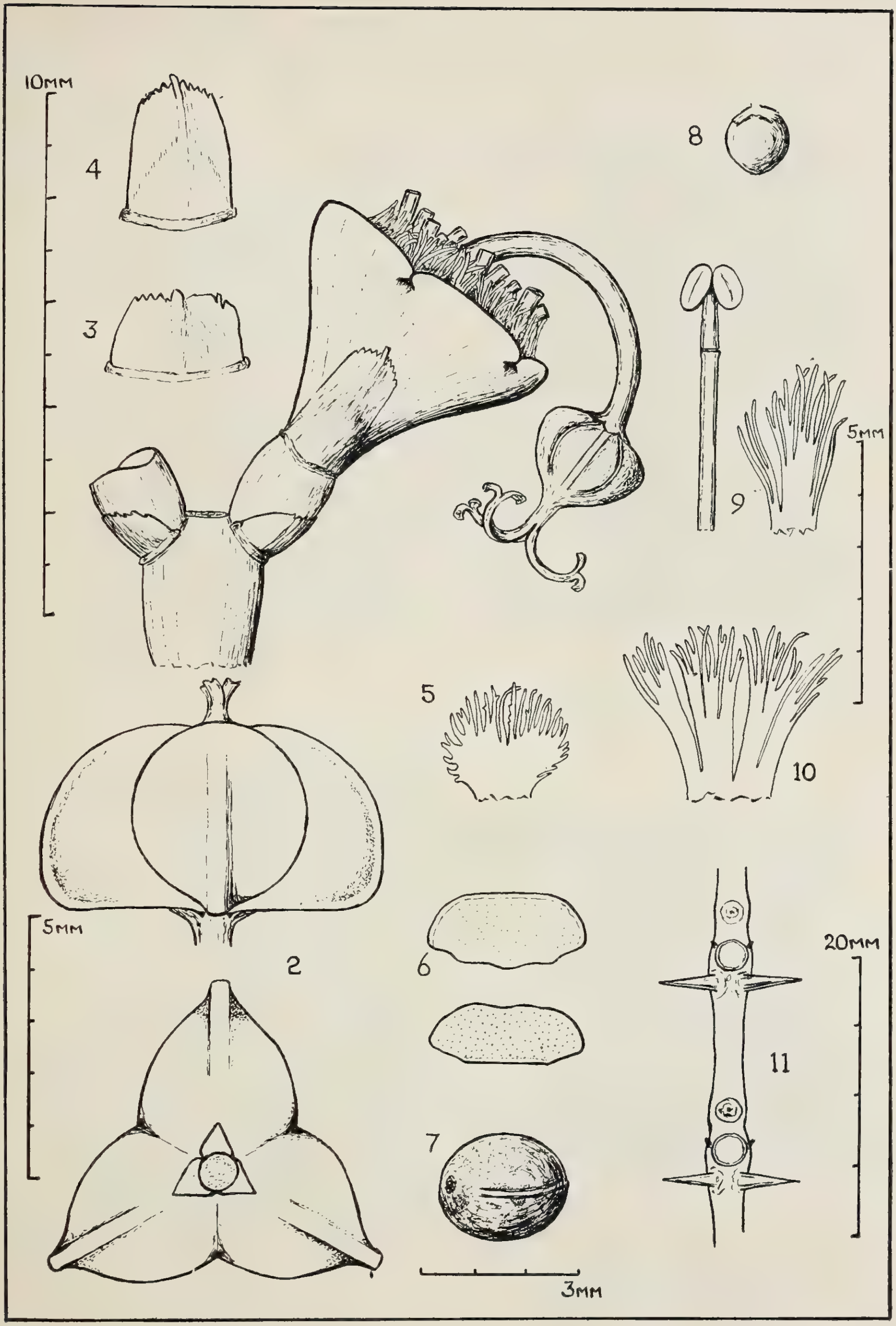
(1) Lateral bisexual cyathium.
(2) Capsule.
(3) Peduncular bract.
(4) Involucral bract.
(5) Involucral lobe.
(6) Involucral gland.
(7) Seed.
(8) Ovule.
(9) Staminate flower with bracteole.
(10) Internal fascicular bract.
(11) Horny margin with spines.

Euphorbia persistentifolia Leach


10MM
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20MM
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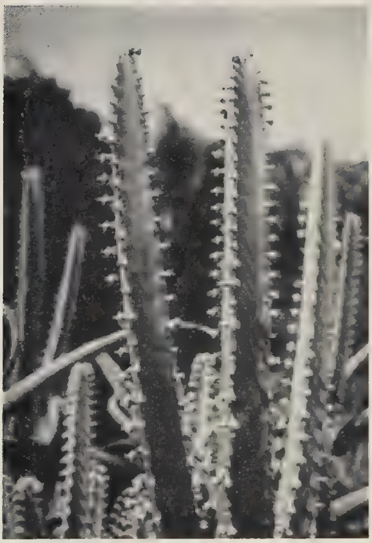

FIG. 1. Cuttings of the type plant in early stage of flowering, shewing ± even margins, weakly armed.

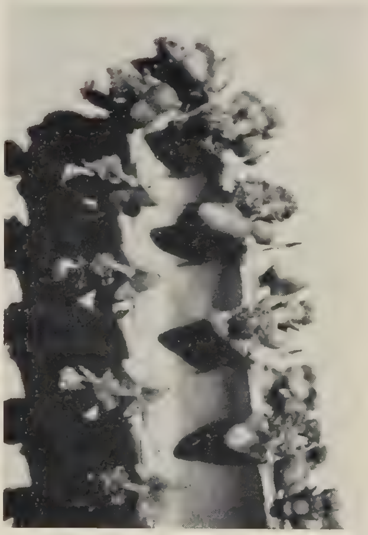

FIG. 3. Apex of fruiting branch.

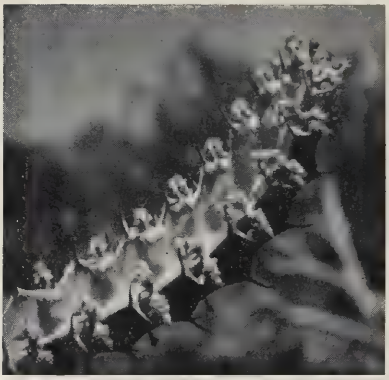

FIG. 2. Strongly armed branch with prominently sinuate dentate margins.

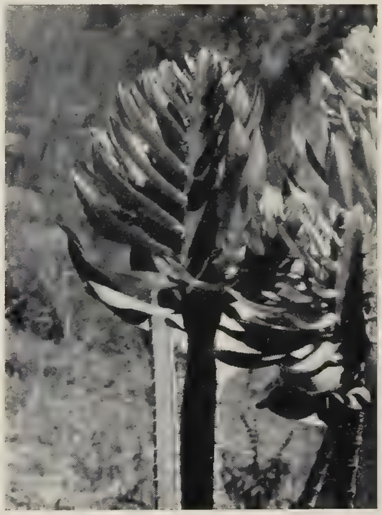

FIG. 4. Cuttings from the type plant in leaf. Cult Nelspruit.

PLATE XLIX. *Euphorbia persistentifolia* Leach persisting for up to 9 months (± leafless when flowering), leaving a relatively conspicuous ± circular scar. *Inflorescence* a single shortly pedunculate cyme of three cyathia arranged in a plane at right-angles to the axis of the branch, produced from the flowering eye 4—6 mm. above the spine pairs; peduncle bibracteate, up to 3 mm. long; bracts depressed ovate, truncate, irregularly dentate; primary cyathium usually male deciduous, sometimes bisexual, the secondary lateral bisexual cyathia are raised on cyme branches up to 3 mm. long; tertiary bisexual cyathia are frequently produced from the axils of the bracts of the lateral cyathia; bracts more or less ovate, irregularly denticulate. *Involucre* infundibuliform 5—6 mm. diam., 3·5—4 mm. long, with 5 erect, transversely broadly elliptic fimbriate lobes c. 2·25 mm. long and 5 oblong-elliptic glands, 2—3 mm. wide, lightly pitted on the somewhat concave or flat upper surface, suberect or spreading, sometimes with a raised lip on the inner margin. *Male flowers* 20—25 (45) arranged in 5 fascicles; fascicular bracts fimbriate laciniate; bracteoles narrow with 2 or 3 filiform fimbria (the fascicular bract and bracteoles becoming reduced as the number of male flowers increases, until with 45 stamina the bract is sometimes absent). *Pistillate flower*: ovary very soon exserted on a long recurved pedicel, sutures and angles usually with a raised rib; ovule under a minute 2-lobed, fringed hood; styles spreading recurved, c. 2·5 mm. long with bifid rugulose apices. *Capsule* obtusely triangular (sometimes 4-locular ± rectangular) truncate, up to 4 mm. long, 7 mm. diam., usually with the sutures and angles distinctly ribbed or keeled, far exserted on a recurved pedicel c. 7 mm. long; perianth ± 3-lobed triangular with the apex of the lobes emarginate, truncate or acute. *Seed* subglobose c. 2·5 × 2 mm., smooth or sometimes very obscurely pustulate, pale brown with irregular brownish cream blotches; suture slightly raised, plainly marked with dark brown lines.

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A REVIEW OF THE SOUTHERN AFRICAN SPECIES OF THELYPTERIS

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ABSTRACT

The taxonomy of the thirteen species of Thelypteris known to occur in Southern Africa is reviewed and a key to these species is provided. A new species, *T. chaseana*, and a new variety, *T. dentata* var. *buchananii*, are described. Six new combinations in this genus are proposed.

Introduction

Sim (1915), following Christensen's 'Index Filicum' (1906), placed ferns now referred to the genera Arthropteris (Davalliaceae), Thelypteris and Ampelopteris (Thelypteridaceae), Dryopteris, Hypodematium, Arachniodes and Ctenitis (Aspidiaceae) under the genus Dryopteris in the wide sense. This classification has since had to be revised in the light of morphological and cytological evidence.

In the genus Thelypteris, as construed here, Sim's treatment at specific level has not proved to be workable as even indusiate and 'non-indusiate' species of this genus appear to have been confused. Also some of the specific epithets used by Sim are not applicable to the Southern African species. Consequently, as many of these are common ferns in this region, it is felt that a review of the species of Thelypteris occurring in Southern Africa, together with a key for their identification, should be presented in advance of a monograph of the pteridophytes of this region. The concept of the genus Thelypteris as construed here follows that of Morton and includes species previously referred to the genera Thelypteris (nom. gen. cons.), Lastrea, Cyclosorus and Leptogramma.

The author wishes to thank Mr. C. V. Morton, Smithsonian Institution, Washington, D.C. for valuable discussion and the Director, Royal Botanic Gardens, Kew, for facilities for study. The author also wishes to acknowledge, with gratitude, the receipt of a grant from the Bremner Travel Fund of the University of Cape Town.

KEY TO THE SOUTHERN AFRICAN SPECIES OF THELYPTERIS

1. Sori elongate, without indusia (Subgen. Leptogramma) .. .. *T. pozoi*
1′. Sori round, with indusia, at least on the immature fronds 2

2. Veins of the pinna lobes free, or the basal veins meeting at the sinus between the pinna lobes or in a membrane extending from the sinus towards the costa (Subgen. Thelypteris) .. 3
2′. One or more pairs of veins of the pinna lobes anastymosing below the sinus between the pinna lobes. (Subgen. Cyclosorus) .. 8
3. Fronds glabrous except for small broad scales borne along the costae on the undersurface of the frond .. *T. palustris* var. *squamigera*
3′. Fronds set with hairs or glands, at least along the costae and veins on the undersurface of the frond .. 4
4. Fronds longly decrescent with a series of reduced auriculate pinnae extending down the 'stipe' .. *T. longicuspis*
4′. Fronds not or gradually decrescent but without a long series of much reduced auriculate pinnae extending down the 'stipe' .. 5
5. Veinlets not anastymosing .. 6
5′. Basal veinlets anastymosing in the sinus or in a membrane extending from the sinus .. 7
6. Undersurface of the lamina with red glands .. *T. strigosa*
6′. Undersurface of the lamina without red glands .. *T. bergiana*
7. Rhizome erect .. *T. gueintziana*
7′. Rhizome horizontal, creeping .. *T. chaseana*
8. One pair of veinlets anastymosing below the sinus .. 9
8′. Two or more pairs of veinlets anastymosing below the sinus .. 11
9. Yellow glands present on the undersurface of the veins .. *T. extensa*
9′. Hairs present on the undersurface of the veins .. 10
10. Fronds gradually decrescent, rhizome creeping .. *T. dentata*
10′. Fronds not decrescent, rhizome erect .. *T. quadrangularis*
11. Lamina proliferous near the apex, rhizome erect .. *T. madagascariensis*
11′. Lamina not proliferous, rhizome creeping .. 12
12. Frond decrescent .. *T. dentata* var. *buchananii*
12′. Frond not decrescent .. 13
13. Veinlets in 6–10 pairs per pinna lobe .. *T. totta*
13′. Veinlets in 15–24 pairs per pinna lobe .. *T. striata*

1. **Thelypteris palustris** Schott var. **squamigera** (Schlechtend.) Tard. in Mém. I.F.A.N., **28**: 119, t.20, figs. 7—9 (1953).

Aspidium thelypteris (L.) Sw. var. *squamigerum* Schlechtend., Adumbr.: 23, t.11 (1825). (Varietal type from Cape Province, S. Africa).

Dryopteris thelypteris (L.) A. Gray var. *squamigera* (Schlechtend.) C. Chr., Ind. Fil.: 297 (1905).

Aspidium squamigerum (Schlechtend.) Fée, Mém. Fam. Foug., **8** : 104 (1857).

Lastrea thelypteris (L.) Bory var. *squamigera* (Schlechtend.) Beddome, Handb. Ferns Brit. India, Suppl.: 54 (1892).

Pteris confluens Thunb., Prod. Pl. Cap.: 171 (1800). (Type from Cape Province, S. Africa; seen at UPS).

Lastrea squamulosa Presl, Tentamen: 76 (1836) nom. nud.

Nephrodium squamulosum Hook. f., Fl. N.Z., **2** : 39 (1855).

Thelypteris squamulosa (Hook. f.) Ching in Bull. Fan Mem. Inst. Biol. Bot., **6** : 5, 329 (1936).

The African and Australasian var. *squamigera* differs from the typical European variety in having small broad scales set along the costae of the pinnae on the undersurface of the frond. This variety seems to have been founded on specimens collected near the Hex River, Cape Province, by Mund and Maire, and possibly by Bergius. The holotype of *Pteris confluens* Thunb. was collected by Thunberg at the Cape. (Schelpe, 1963).

2. **Thelypteris bergiana** (Schlechtend.) Ching in Bull. Fan Mem. Inst. Biol. Bot., **10** : 251 (1941).

Polypodium bergianum Schlechtend., Adumbr.: 20, t.9 (1825). (Type from Cape Province, S. Africa).

Lastrea bergiana (Schlechtend.) Moore, Index : 86 (1858).

Nephrodium bergianum (Schlechtend.) Bak., Syn. Fil: 269 (1867).

Dryopteris bergiana (Schlechtend.) O. Kuntze, Rev. Gen. Pl., **2** : 812 (1891).

Nephrodium sewellii Bak. in Journ. Linn. Soc., Lond., **15** : 418 (1876). (Type from Madagascar; seen at K).

Dryopteris sewellii (Bak.) C. Chr., Ind. Fil.: 292 (1905).

Nephrodium anateinophlebium Bak. in Journ. Linn. Soc., Lond., **16** : 202 (1877). (Type from Madagascar; seen at K).

Dryopteris anateinophlebia (Bak.) C. Chr., Ind. Fil.: 252 (1905).

Aspidium maranguense Hieron. in Engler, Pflanzenw. Ost.-Afr., C : 85 (1895). (Type from East Africa).

Dryopteris maranguensis (Hieron.) C. Chr., Ind. Fil.: 252 (1905).

Lastrea maranguensis (Hieron.) Copel., Gen. Fil.: 139 (1947).

Dryopteris palmii C. Chr. in Ark. f. Bot., **14** : 1, t.2, fig. 6 (1916). (Type from Madagascar).

T. bergiana has been confused widely with *T. gueintziana* in the past. In *T. bergiana* the indusia are very small and are only visible on immature fronds. Later they become detached or enveloped by the maturing sorus, whereas the larger pilose indusia of *T. gueintziana* are persistent.

3. **Thelypteris strigosa** (Willd.) Tard. in Humbert, Fl. Madag., Polypod., **1** : 274 (1958).

Aspidium strigosum Willd. in L., Sp. Pl., ed. iv, **5** : 249 (1810). (Type from Mauritius; seen in Herb. Willd., B).

Nephrodium strigosum (Willd.) Desv. in Mém. Soc. Linn., Par., **6** : 256 (1827).

Lastrea strigosa (Willd.) Presl, Tentamen : 75 (1836).

Dryopteris strigosa (Willd.) C. Chr., Ind. Fil.: 295 (1905).

Aspidium pulchrum Bory ex Willd. in L., Sp. Pl., ed. iv, **5 :** 253 (1810). (Type from Réunion).

Nephrodium pulchrum (Bory ex Willd.) Desv. in Mém. Soc. Linn., Par., **6** : 256 (1827).

Lastrea pulchra (Bory ex Willd.) Presl, Tentamen : 75 (1836).

Typical *T. strigosa* is superficially similar to small forms of *T. bergiana* but has the undersurface of the lamina set with numerous small red glands. In Southern Africa, it is so far only known from the eastern districts of Southern Rhodesia.

4. **Thelypteris longicuspis** (Bak.) Schelpe comb. nov.

Nephrodium longicuspe Bak. in Journ. Linn. Soc. Lond., **16** : 202 (1877)—basionym. (Type from Madagascar; seen at K).

Aspidium longicuspe (Bak.) Kuhn in v. Decken Reisen, **3** (3) Bot.: 65 (1879).

Dryopteris longicuspis (Bak.) C. Chr., Ind. Fil.: 275 (1905).

Nephrodium zambesiacum Bak. in Ann. of Bot., **5** : 318 (1891). (Type from Nyasaland; seen at K).

Aspidium zambesiacum (Bak.) Hieron. in Engler, Pflanzenw. Ost-Afr., C : 85 (1895).

Dryopteris zambesiaca (Bak.) C. Chr., Ind. Fil.: 318 (1905).

Thelypteris zambesiaca (Bak.) Tard. in Not. Syst., **14** : 345 (1952).

Specimens of *T. longicuspis* from the African mainland have been referred to *T. zambesiaca* in the past. However, an examination of the types of these two species at Kew shows that there are no significant differences between them. The abruptly decrescent base of the frond with a long series of much reduced auriculate pinnae extending down the stipe is characteristic. It is only known as far south as Southern Rhodesia.

In the typical form, the indusia are only set with small glands but some plants from the eastern districts of Southern Rhodesia have more or less pilose indusia (e.g. *Chase 4627, 4628, 4665, 5577*). These have been referred erroneously to the West African *T. guineensis* (Christ in Cheval.) Alston.

5. **Thelypteris gueintziana** (Mett.) Schelpe comb. nov.

Aspidium gueintzianum Mett., Pheg. u. Asp.; 83, n. 201 (1858)—basionym. (Type from Natal, S. Africa; seen at B).

Lastrea gueintziana (Mett.) Moore, Index : 93 (1858).

Nephrodium gueintzianum (Mett.) Hieron. in Bot. Jahrb., **28** : 341 (1900).

The typical form of *T. gueintziana* from Natal and the Cape Province has conspicuously attenuated apices to the pinnae. This apparently grades northwards into plants with more blunt pinna apices described as *T. pseudogueintziana* Bonap., described from the Congo. The latter was described as having a creeping rhizome, a description which is not in accord with the type specimen which was seen at Kew on loan from Paris. In this specimen the rhizome is curved, probably as a result of the plant gradually toppling as it grew. Furthermore the comment that *T. pseudogueintziana* differs from *T. gueintziana* in lacking yellow glands on the lower surface is misleading, as the type of *T. gueintziana* is devoid of yellow glands.

6. **Thelypteris chaseana** Schelpe sp. nov.

Rhizoma repens, 11 mm. diam., paleis lanceolatis, 8 mm. longis, integris brunneis vestitis. Stipes teres stramineus 61 cm. longus, paleis ad basim lanceolatis brunneis. Lamina bipinnatifida ambitu lanceolata, pinnis infimis nonnihil reductis et deflexis. Rachis straminea villosa. Pinnae cultratae acutae, 15 cm. longae, 2 cm. latae, pinnatisectis fere ad costam, lobis anguste oblongis, leviter falcatis, venulis c. 11-jugis, costis venulisque supra et subtus pilosis, venulis basalibus confluentibus, sive fere confluentibus, ad sinum. Sori c. 12 per lobus pinnarum, indusiis parvis pilosis.

Rhizome creeping, 11 mm. diam., clothed in lanceolate entire brown scales c. 8 mm. long. Stipe stramineous 61 cm. long with brown scales at the base. Lamina lanceolate in outline, 78 cm. long (up to 1.2 m.), 30 cm. broad with the lowest three pairs of pinnae deflexed and somewhat reduced. Rachis stramineous, villous. Pinnae c. 15 cm. long, 2 cm. broad, cultrate acute. pinnatisect almost to the costa, the lobes narrowly oblong, somewhat falcate each with about 11 pairs of veins, the costae and veins pilose above and below and with only the basal veinlets joining, or almost joining, in a membrane at the sinus; the basal acroscopic pinna lobe larger than the rest. Sori about 12 per pinna lobe, situated halfway between the margin and the costule; indusia small, pilose.

HOLOTYPE: South West Africa, Otjiwarongo district, Grosse Waterberg above Waterberg Station; locally common along perennial stream in bush in shade on south aspect. 5200 ft. alt. 14. vii. 1954. *Schelpe* 4791 (BOL).

PARATYPES: SOUTH WEST AFRICA: Great Waterberg, *Rodin* 2593 (BOL, K).

RHODESIA: Goromonzi district, 38 mls. N.E. of Salisbury, on Shamva road, *Mitchell* 584 (BOL ex SRGH); Goromonzi district, Chishawasha, *Mitchell* 565 (BOL ex SRGH); Melsetter district, between Cashel and Melsetter, *Schelpe* 4013 (BOL); Umtali district, near Odzani River bridge, *Schelpe* 5652 (BOL).

MALAWI: c.4 mls. S. of Dedza, *Robson* 1423 (K).

ZAMBIA: Kashitu River, *Rogers* 8308 (K).

TANZANIA: Arusha district, Sokon, near Arusha, *Milne-Redhead & Taylor* 7026*a* (K); Iringa district, Kilolo, Dabaqa Highlands, *Polhill & Paulo* 1430 (K).

ANGOLA: Golungo Alto, Rio Cuanzo, near Sange, *Welwitsch* 130 (K).

T. chaseana is readily distinguished from *T. gueintziana* by its creeping rhizome, a part of the plant unfortunately but frequently neglected by collectors. In some specimens seen, which may be referable to this species, the indusia are glandular as well as pilose. This new species is named after Mr. N. C. Chase

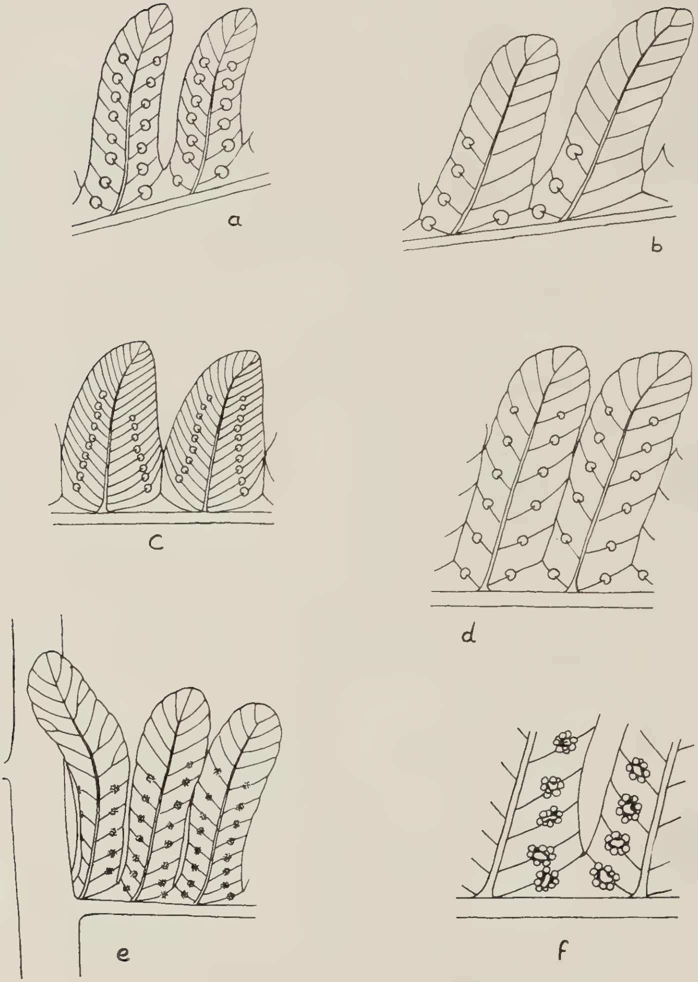

FIG. 1.

Diagrams of venation in some Southern African species of Thelypteris. (*a*) *T. gueintziana* (X 3). (*b*) *T. quadrangularis* (X 3). (*c*) *T. striata* (X 3). (*d*) *T. dentata* var. *buchananii* (*X 3*). (*e*) *T. chaseana* basal acroscopic pinna lobes (X 3). (*f*) *T. chaseana*, sinus between pinna lobes (X 6).

of Umtali who has done extremely valuable field work on the ferns of Rhodesia and Moçambique.

7. **Thelypteris dentata** (Forsk.) E. St. John. in Amer. Fern. Journ., **26** : 44 (1936).

Polypodium dentatum Forsk., Fl. Aegypt. Arab.: 185 (1775). (Type from Yemen; seen at C).

Dryopteris dentata (Forsk.) C. Chr. in Vid. Selsk. Skr., Afd. 8, **6** : 24 (1920).

Cyclosorus dentatus (Forsk.) Ching in Bull. Fan Mem. Inst. Biol. Bot., **8** : 206 (1938).

Aspidium natalense Fée, Mém. Fam. Foug., **8** : 102 (1857). (Type from Natal, S. Africa).

Nephrodium hispidulum Peter in Fedde Rep. Sp. Nov., Beih., **40** : descr. 10, t.4, figs. 1-2 (1929). (Type from S. Rhodesia).

Although this species is remarkably uniform through its distribution range in Africa and elsewhere, a few unusually large specimens similar to *T. dentata* have been found. These differ from typical *T. dentata* in having two or three pairs of veins anastymosing below the sinus whereas only a single pair anastymose in typical *T. dentata.* Also there are consistently fewer reduced basal pinnae than in luxuriant forms of typical *T. dentata.* Since a small number of specimens appear to be intermediate between the typical species and the more luxuriant plants, described here as var. *buchananii*, this new taxon has not been given specific rank.

Thelypteris dentata (Forsk.) E. St. John var. **buchananii** Schelpe var. nov.

Differt a varietata typica, planta robustiori, venulis 2—3 jugis basalibus confluentibus sub sinum.

VARIETAL HOLOTYPE: MOÇAMBIQUE, Manica e Sofala, Garuso, "Jaegersberg" (Bandula Mountain); locally frequent on streambank in forest. 2,600 ft. alt., 11. vii. 1955. *Schelpe* 5599 (BOL).

VARIETAL PARATYPES: SOUTH AFRICA: Natal, Durban district, Bush Swamp, *Buchanan* 8 (K).

RHODESIA: Melsetter district, Chimamimani Mountains, east bank of Haroni Gorge, *Mitchell* 401 (BOL).

MOÇAMBIQUE: Manica e Sofala, Bandula, *Chase* 6196 (BOL ex SRGH); Garuso, *Schelpe* 5603 (BM. BOL); Zambesia, Metolola, *Barbosa & Carvalho 3999* (BOL).

Specimens of the var. *buchanani* from Moçambique were erroneously referred by Alston (1954) to the West African *Cyclosorus venulosus* (Hook.) Tard. As this name is based on *Nephrodium venulosum* Hook. non. Kunze, it should be known as *Thelypteris elata* (Mett. ex Kuhn) Schelpe comb. nov. (Basionym: *Aspidium elatum* Mett. ex Kuhn, Fil. Afr.: 130 (1868)).

The Mascarene *Nephrodium mauritianum* Fée non Desv. is even more distinct from *T. dentata* var. *buchananii* in that it has the frond abruptly and longly decrescent into a long series of much reduced auriculate pinnae. As the next available name for *Nephrodium mauritianum* Fée non Desv. appears to be *Nephrodium leuconevron* Fée this Mascarene plant should be known as *Thelypteris leuconevron* (Fée) Schelpe comb. nov. (Basionym: *Nephrodium leuconevron* Fée, Mém. Fam. Foug., **5** : 306, t. 18, fig. 3 (1852)).

8. **Thelypteris quadrangularis** (Fée) Schelpe in Journ. S. Afr. Bot., **30** : 196 (1964).

Nephrodium quadrangulare Fée, Mém. Fam. Foug., **5** : 308 (1852). (Type from British Guiana).

Dryopteris quadrangularis (Fée) Alston in Journ. of Bot., **75** : 253 (1937).

Cyclosorus quadrangularis (Fée) Tard. in Not. Syst., **14** : 345 (1952).

Dryopteris contigua Rosenst. in Meded. Rijksherb., Leiden, n. 31 : 8 (1917). (Type from Borneo).

Cyclosorus contiguus (Rosenst.) Copel., Gen., Fil.: 142 (1947).

Although no material of the type collection of *Nephrodium quadrangulare* Fée has been found, the African plants referred to this species are almost certainly conspecific with specimens from the type area and neighbouring parts of South America which agree with the type description.

The very obtuse angle formed by the anastymosis of the lowest veinlets is characteristic.

9. **Thelypteris extensa** (Blume) Morton in Amer. Fern Journ., **49** : 113 (1959).

Aspidium extensum Blume, Enum. Pl. Jav.: 156 (1828). (Type from Java).

Dryopteris extensa (Blume) O. Kuntze, Rev. Gen. Pl., **2** : 812 (1891).

Cyclosorus extensus (Blume) H. Ito in Bot. Mag. Tokyo, **51** : 713, fig. 6 (1937).

Nephrodium wakefieldii Bak. in Ann. of Bot., **5** : 326 (1891). (Type from Kenya; seen at K).

Aspidium wakefieldii (Bak.) Hieron. in Engler, Pflanzenw. Ost-Afr., C : 85 (1895).

Dryopteris wakefieldii (Bak.) C. Chr., Ind. Fil.: 301 (1905).

Cyclosorus wakefieldii (Bak.) Ching in Bull. Fan. Mem. Inst. Biol. Bot., **10** : 250 (1941).

T. extensa is a widespread species of the Old World tropics which is easily recognised by the non-decrescent bases of the fronds, the numerous yellow glands along the veinlets on the undersurface, and the narrowed bases of the lowest pinnae.

According to Posthumus (1937), *Aspidium extensum* Blume is a synonym of *Nephrodium impressum* Desv., an earlier name based on a specimen from Timor, but it has not been possible to check this opinion.

10. **Thelypteris madagascariensis** (Fée) Schelpe comb. nov.

Goniopteris madagascariensis Fée, Mém. Fam. Foug., **5** : 251 (1852) (Type from Madagascar)—basionym.

Dryopteris madagascariensis (Fée) C. Chr., Ind. Fil.: 276 (1905).

Cyclosorus madagascariensis (Fée) Ching in Bull. Fan Mem. Inst. Biol. Bot., **10** : 246 (1941).

Goniopteris patens Fée, Mém. Fam. Foug., **5** : 253 (1852). (Type from Natal, South Africa).

Nephrodium patens (Fée) J. Sm., Hist. Fil.: 208 (1878) non (Sw.) Desv. (1827).

Cyclosorus patens (Fée) Copel., Gen. Fil.: 143 (1947).

Gymnogramme unita Kunze in Linnaea, **18** : 115 (1844) non *Cyclosorus unitus* (L.) Ching (1932) (Type from Natal).

Phegopteris unita (Kunze) Mett., Farng., Pheg. u. Asp.: n. 42 (1858).

Polypodium unitum (Kunze) Hook., Sp. Fil., **5** : 5 (1863) non L. (1759).

Goniopteris unita (Kunze) J. Sm., Hist. Fil.: 192 (1875).

Gonipteris silvatica Pappe & Raws., Syn. Fil. Afr. Austr.: 39 (1858) nom. illegit. (Type from Natal).

Dryopteris silvatica (Pappe & Raws.) C. Chr., Ind. Fil.: 292 (1905).

Cyclosorus silvaticus (Pappe & Raws.) Ching in Bull. Fan. Mem. Inst. Biol. Bot., **10** : 249 (1941).

Nephrodium costulare Bak. in Journ. Linn. Soc., Lond., Bot., **16** : 203 (1877) (Type from Madagascar).

Dryopteris costularis (Bak.) C. Chr., Ind. Fil.: 258 (1905).

Cyclosorus costularis (Bak.) Adams & Alston in Bull. Brit. Mus. Nat. Hist., Bot., **1** : 158 (1955).

Dryopteris gladiata C. Chr. in Ark. f. Bot., **14** (19) : 4, t. 1 (1916). (Type from Madagascar).

T. madagascariensis was previously known in South Africa as *Dryopteris silvatica* (Pappe & Raws.) C. Chr. by Sim (1915) and later authors.

11. **Thelypteris totta** (Thunb.) Schelpe in Journ. S. Afr. Bot., **29** : 91 (1963).

Polypodium tottum Thunb., Prod. P1. Cap.: 172 (1800). (Type from Cape Province, South Africa; seen at UPS).

Aspidium goggilodus Schkuhr, Krypt. Gew., **1** : 193, t.33c (1809). (Type from British Guiana).

Polystichum goggilodus (Schkuhr) Gaud. in Freyc., Voy. Bot.: 326 (1827).

Cyclosorus goggilodus (Schkuhr) Link, Hort. Berol., **2** : 128 (1833).

Dryopteris goggilodus (Schkuhr) O. Kuntze, Rev. Gen, Pl., **2** : 811 (1891) ex err. "gongylodes"; emend. Fosberg in Occ. Pap. Bishop Mus., **16** : 337 (1942).

Thelypteris goggilodus (Schkuhr) Small, Ferns S. E. States: 248 (1938) ex err. "gongylodes".

Aspidium ecklonii Kunze in Linnaea, **10** : 546 (1836). (Type from Cape Province, S. Africa).

Nephrodium plantianum Pappe & Raws., Syn. Fil. Afr. Austr.: 139 (1868). (Type from Natal, S. Africa).

Aspidium plantianum (Pappe & Raws.) Kuhn, Fil. Afr.: 139 (1868).

T. totta was found to be the correct name for the plant previously known in South Africa as *Dryopteris gongylodes* (Schkuhr) O. Kuntze. (Schelpe, 1963).

12. **Thelypteris striata** (Schum.) Schelpe comb. nov.

Aspidium striatum Schum. in Kongel. Dansk. Vid. Selsk., Afd. 4: 230 (1829). (Type from Guinea, West Africa; seen in C)—basionym.

Dryopteris striata (Schum.) C. Chr., Ind. Fil.: 294 (1905).

Cyclosorus striatus (Schum.) Copel., Gen. Fil.: 143 (1947).

Polypodium pallidivenium Hook., Sp. Fil., **5** : 8 (1863). (Type from West Africa.)

Nephrodium pallidivenium (Hook.) Bak. in Hook. & Bak., Syn. Fil.: 290 (1867).

Dryopteris hemitelioides Christ in Ann. Mus. Congo, **5** : 26 (1909). (Type from Congo).

T. striata is a predominantly tropical African species which is usually easily distinguishable from *T. totta* by its much larger size and longer pinna lobes, each of which has 15 to 24 pairs of veinlets. In Southern Africa, it is as yet only known from the Victoria Falls.

13. **Thelypteris pozoi** (Lagasca) Morton in Bull. Soc. Bot. France, **106** : 234 (1959).

Hemionitis pozoi Lagasca, Nov. Gen. et Sp.: 33 (1816). (Type from Spain).

Gymnogramma pozoi (Lagasca) Desv. in Mém. Soc. Linn., Par., **6** : 216 (1827).

Ceterach pozoi (Lagasca) A. Br. ex Milde in Bot. Zeit., **1886** : 310 (1886) nom., excl. descr.

Pleurosorus pozoi (Lagasca) Trevis. in Atti Soc. Ital. Sc. Nat., **17** : 256 (1875).

Leptogramma pozoi (Lagasca) Heywood in Fedde Rep. Sp. Nov., **64** : 19 (1961).

Stenogramma pozoi (Lagasca) Iwatsuki in Acta Phytotax. et Geobot., **19** : 124 (1963).

Polypodium tottum Willd. in L., Sp. Pl., ed. iv. **5** : 201 (1810) non Thunb. (1800). (Type from Cape Province, S. Africa).

Gymnogramma totta (Willd.) Schlechtend., Adumbr.: 15, t.6 (1825).

Grammitis totta (Willd.) Presl, Tentamen : 209, t.9, fig. 4 (1836).

Leptogramma totta (Willd.) J. Sm. in Journ. of Bot., **4** : 52 (1841).

Phegopteris totta (Willd.) Mett., Farng., Pheg. u. Asp.: 18, n.31 (1858).

Aspidium tottum (Willd.) Engl., Hochgeb. fl. trop. Afr.: 99 (1892).

Nephrodium tottum (Willd.) Diels in Engl. & Prantl, Nat. Pflanzenfam., **1** (4) : 170 (1899).

Lastrea totta (Willd.) Ohwi in Bull. National Sci. Mus. Tokyo, ser. 2, **3** : 98 (1956).

Acrostichum pilosiusculum Wikstr. in Kong. Vet. Acad. Handl., **1825** : 439 (1826). (Type from Madeira; seen in S-PA).

Leptogramma pilosiuscula (Wikstr.) Alston in Bol. Soc. Brot., ser. 2, **30** : 17 (1956).

Polypodium africanum Desv. in Mem. Soc. Linn. Par., **6** : 239 (1827) (nom. nov. for *P. tottum* Willd. non. Thunb.).

Dryopteris africana (Desv.) C. Chr., Ind. Fil.: 250 (1905).

Aspidium africanum (Desv.) Aschers. & Graebn., Syn. Mitteleurop. Fl., ed. ii, **1** : 28, 153 (1912).

Leptogramma africana (Desv.) Nakai ex Mori, Enum. Pl. Corea: 13 (1922).

Lastrea africana (Desv.) Copel., Gen. Fil. : 138 (1947).

Polypodium eliasii Sennen & Pau in Bull. Soc. geogr. Bot., Mans. **1910** : 94 (1910).

This taxon and similar species with exindusiate elongated sori have usually been referred to the genus Leptogramma. However, Morton (priv. commun.) maintains that a few South American species are intermediate between Leptogramma and Thelypteris and that Leptogramma cannot be upheld as a separate genus. *T. pozoi* is the correct name in this genus for the plant previously known in South Africa as *Dryopteris africana* (Desv.) C. Chr.

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A NEW ALOE FROM KENYA

G. W. Reynolds

(With Plate XLI)

Aloe classenii Reynolds. Species nova, affinis *A. percrassa* Tod. floribus brevibus, sed tota planta multo minore differt.

Planta succulenta, acaulis vel caulibus usque 50 cm. longis, mox caespitosa. *Folia* c. 24, rosulata, lanceolata, 35—40 cm. longa, 7—8 cm. lata; *supra* viridia, interdum rubescentia, plana vel leviter canaliculata; *subtus* convexa, ad margines sinuato-denticulata, dentibus deltoideis pungentibus usque 5 mm. longis 10—15 mm. distantibus armata.

Inflorescentia paniculata, c. 10-ramosa, c. 60 cm. alta. *Racemi* laxi, cylindrico-acuminati, 7 cm. longi, 4 cm. diam. *Pedicelli* 8—10 mm. longi. *Bracteae* ovato-acutae, 3 mm. longae et latae, 3-nervatae. *Perianthium* vinaceum, cylindrico-trigonum, rectum 20—25 mm. longum; *segmenta exteriora* per 10 mm. libera. *Antherae* 3 mm. exsertae. *Stigma* demum 4 mm. exsertum. *Ovarium* viridulum, 4 mm. longum, 2 mm. diam.

Kenya. On Kirima Rocks, about 15 miles SSW of Mackinnon Road Railway Station, cult, Mbabane, Swaziland, fl 20 June 1965, Reynolds 10117 (Classen C.128) holotype (PRE), isotype (K, EA).

This most interesting Aloe was collected by Mr. George Classen of Nairobi, Kenya, on prominent gneissic outcrops called Kirima, 2 miles south of a small rock Pika Pika, about 15 miles SSW of the Mackinnon Road railway station on a track leading to Kilibasi, at approx. 3° 53′ S., 38° 53′ E. Plants form dense groups sometimes a few yards across. When in full sun on rocks, leaves turn a bronze-red colour, but are a dark green with reddish tinge in partial shade. The leaf apex is a spine.

The perianth is unique in having a broad raised median keel in the upper half of the inner segments, which keel actually separates the outer segment margins by 1 mm. and more. In the bud stage the double indentation can be clearly seen.

A. classenii appears to be nearest allied to *A. percrassa* Tod. in floral characters, but differs in being a much smaller plant with an inflorescence only 60 cm. high, and in having rosy-vinaceous flowers much resembling those of *A. myriacantha* (Haw.) R & S in colour. In cultivation *A. classenii* does not flower freely; in each raceme only a few flowers open at a time. If not watered freely, buds and flowers tend to dry out and fall.

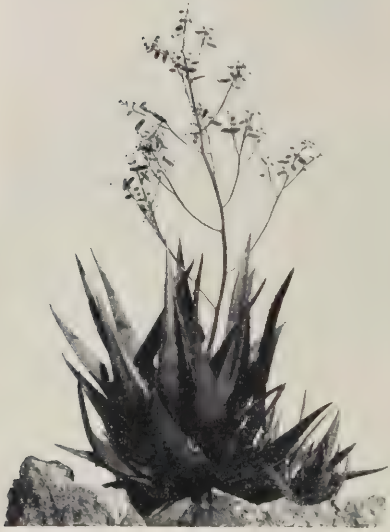

Fig. 1.

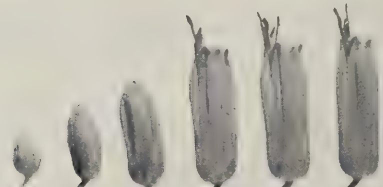

Fig. 2.

PLATE XLI

Aloe classenii Reynolds

Fig. 1. Plant from Kirina Rocks, 15 miles SSW of Mackinnon Road Station, between Mombasa and Voi, Kenya, flowering at Mbabane, Swaziland. Height 60 cm.

Fig. 2. Buds and flowers 1/1.

DESCRIPTION. *Plants* acaulescent or with stems 50 cm. long, increasing freely from shoots and forming dense groups sometimes a few metres across.

Leaves about 24, densely rosulate, lanceolate, 35—40 cm. long, 7—8 cm. broad at base, suberectly spreading and forming rather compact rosettes about 40 cm. across; *upper surface* deep olive-green to reddish-bronze without spots or markings, flat low down slightly concave upwards; *lower surface* convex, more or less as the upper surface except sometimes with a few small elongated pale spots near base; *margins* sinuate-dentate, armed with pale-brownish pungent deltoid teeth up to 5 mm. long, 10—15 mm. apart, the leaf apex a spine.

Inflorescence a many-branched panicle about 60 cm. high, about 10-branched from below the middle, the branches slender, the lowest with 2—3 branchlets, producing a total of about 25 racemes.

Peduncle minutely white-flecked, with a powdery bloom, basally plano-convex and 14 mm. broad.

Racemes laxly flowered, cylindric-acuminate, about 7 cm. long, 4 cm. diam., the buds rather globular.

Pedicels 8—10 mm. long, nutant at apex.

Bracts very small, ovate-acute, 3 mm. long and broad, 3-nerved.

Perianth deep brownish-vinaceous (R.C.S. XXXIX) with a powdery bloom, cylindric-trigonous, straight, 20—25 mm. long, 7 mm. diam. across the ovary, trigonous upwards, the mouth open; *outer segments* free for 10 mm., obscurely 3-nerved; *inner segments* free but dorsally adnate to the outer to the middle, with a broad large vinaceous keel which is raised and separates the margins of the outer segments by 1 mm. or more.

Filaments very pale lemon, with their *anthers* in turn exserted 3—4 mm. *Stigma* at length exserted 4 mm. *Ovary* pale-green, 4 mm. long, 2 mm. diam.

ACKNOWLEDGMENTS

I am greatly indebted to:

Mr. George Classen of Nairobi, Kenya, for plants of this new species with photographs and much data, also for plants of several other East African species of Aloe, some of which are new and awaiting description.

Dr. L. E. Codd, Chief, Botanical Research Institute, Pretoria, for the facilities of the National Herbarium, and for many photographs from my negatives.

The South African Council for Scientific and Industrial Research, Pretoria, for travelling and other grants that have enabled me to investigate the Aloes in most parts of Africa.

A NEW ALOE FROM TANZANIA

G. W. Reynolds

(With Plates XLII and XLIII)

Aloe leachii Reynolds. Species nova, affinis *A. secundiflora* Engler, sed tota planta minore, racemis laxioribus, floribus brevioribus differt.

Planta succulenta, acaulis vel breviter caulescens. *Folia* c. 20, rosulata, usque 35 cm. longa, 6 cm. lata, sensim attenuata; *supra* basi plana, superne leviter canaliculata, viridula, rubescentia; *subtus* convexa; marginibus dentibus deltoideis brunneis, 5 mm. longis, 10—20 mm. distantibus armata.

Inflorescentia paniculata, 7—10-ramosa, usque 1 m. alta.

Racemi laxi, subsecundiflores, 15—20 cm. longi, 7 cm. diametro. *Pedicelli* 6—8 mm. longi. *Bracteae* parvae, ovato-acutae, 5 mm. longae, 4 mm. latae, 3—5-nervatae.

Perianthium coccineum, cylindrico-trigonum, 30 mm. longum, circa ovarium 7 mm. diam.; *segmenta exteriora* per 15 mm. libera; *interiora* latiora, carinata. *Antherae* per 1—2 mm. exsertae. *Stigma* demum 2—3 mm. exsertum. *Ovarium* viridulum, 6 mm. longum, 3 mm. diam.

Tanzania (Tanganyika). Eastern Province, 18 miles west of Bagamoyo Ferry on road westwards to Msata, cult. "Farview" Greendale (Rhodesia), fl. 26 May 1963, Leach et Brunton 10178 holotype (PRE); cult. Mbabane, Swaziland fl. 15 Aug. 1964, Leach 10178 in Reynolds 10125, (K).

A. leachii is named after Mr. L. C. Leach of Greendale, Salisbury, who discovered plants about 18 miles inland (westwards) from Bagamoyo Ferry, Tanzania (Tanganyika) on the road to Msata, more or less in open woodland, at an altitude of about 900 ft.

A. leachii is allied to *A. secundiflora* Engler in having widely spreading inflorescence branches, and more or less subsecund flowers, but differs in being a smaller plant, with much laxer racemes that are not so markedly secund, and in having smaller flowers that are not, or only very slightly, minutely white-flecked. In *A. leachii* the terminal raceme is ascending with the flowers more evenly distributed around the axis; the flowers also have a slightly striped effect compared with those of *A. secundiflora*.

Description. Plant succulent, acaulous or shortly caulescent, growing singly or with a few offshoots from base forming small groups.

Leaves about 20, rosulate, suberectly spreading, up to 35 cm. long, 6 cm. broad at base, gradually narrowing to an acute apex; *upper surface* flat low

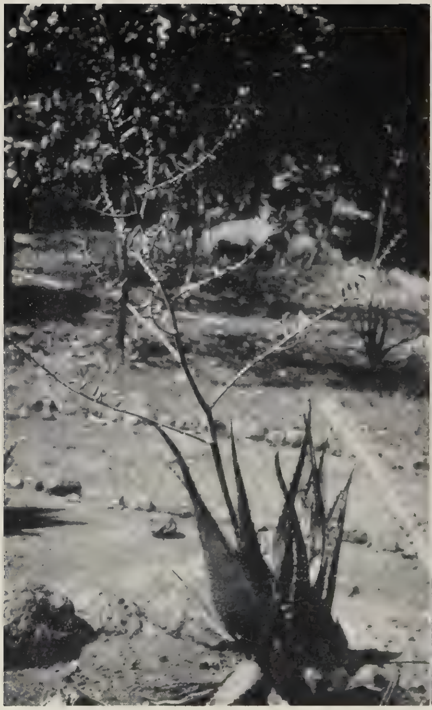

Fig. 1.

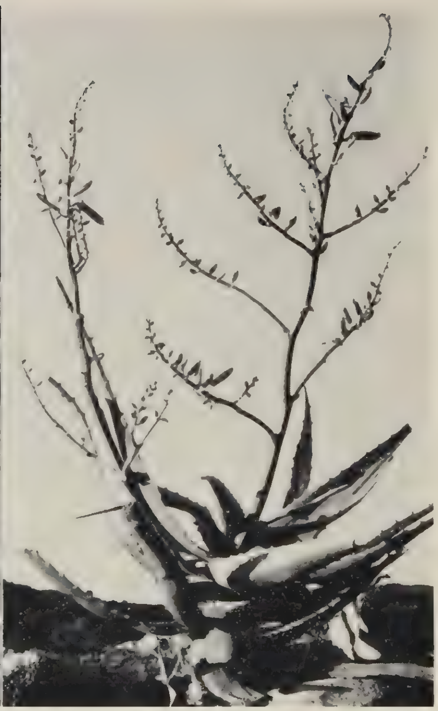

Fig. 2.

PLATE XLII

Aloe leachii Reynolds

FIG. 1. Plant from 18 miles west of Bagamoyo Ferry, Tanzania, flowering at Greendale, Rhodesia. Height 1 in.
FIG. 2. Plant from same locality flowering at Mbabane, Swaziland. Height 1 in.

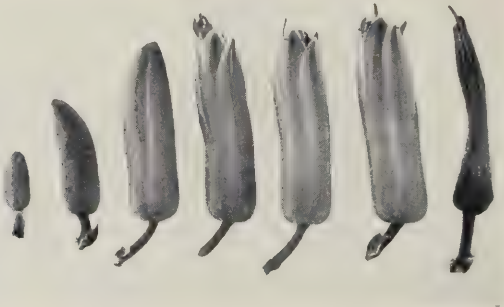

PLATE XLIII

Aloe leachii Reynolds

Buds and flowers natural size.

down, slightly canaliculate upwards, uniformly dark green with reddish tinge, without spots or markings; *lower surface* convex, otherwise as the upper; *marginal teeth* reddish-brown, pungent, deltoid about 5 mm. long and 10—20 mm. distant.

Inflorescence 2 simultaneously, up to 1 m. high, divaricately 7—10-branched from below the middle, the lowest branches sometimes with 1—2 branchlets, the *peduncle* plano-convex and 15—20 mm. broad at base.

Racemes cylindric, 15—20 cm. long, 7 cm. diam., very laxly flowered, the terminal ascending with the flowers more or less evenly distributed around the axis, the others sometimes almost horizontal and with their flowers more or less secund.

Pedicels 6—8 mm. long.

Bracts small, ovate-acute, dirty-white, 5 mm. long, 4 mm. broad, 3—5-nerved.

Perianth scarlet, paler at mouth, slightly striped, cylindric-trigonous, 30 mm. long, basally rounded, cylindric and 7 mm. diam. across the ovary, trigonous upwards; *outer segments* free to the middle (15 mm.), paler at the margins, the pale colour continuing to base and giving the flower a somewhat striped effect; *inner segments* broader than the outer, with broad pale-orange border, and with 3 crowded nerves forming a scarlet keel, the apices more obtuse, more spreading than the outer.

Anthers exserted 1—2 mm. *Stigma* at length exserted 2—3 mm. *Ovary* olive-green, 6 mm. long, 3 mm. diam.

ACKNOWLEDGMENTS

I am deeply indebted to:

Mr. Larry C. Leach of Greendale, Salisbury, for a large number of Aloe plants from many parts of Rhodesia, Malawi, Tanzania, Moçambique and elsewhere in Africa, for many photographs and Kodachromes and much other data and assistance over many years. Mr. Leach has also collected and contributed a considerable amount of Aloe and other material to various Herbaria, especially SRGH and PRE.

Dr. L. E. Codd, Chief, Botanical Research Institute, Pretoria, for the facilities of the National Herbarium and for many photographs from my negatives.

The S.A. Council for Scientific and Industrial Research, Pretoria, for travelling grants that have enabled me to investigate the Aloes almost throughout Africa.

TWO NEW ALOES FROM MADAGASCAR

G. W. Reynolds

(With Plates XLIV–XLVII)

Aloe fievetii Reynolds. Species nova, affinis *A. capitata* Bak, foliis angustioribus brevioribusque, inflorescentia breviore 2-ramosa, segmentibus exterioribus ad 13 mm. liberis, genitalibus brevissime exsertis differt.

Planta acaulis vel breviter caulescens. *Folia* 12—16, dense rosulata, patentia, lanceolato-attenuata, 30—35 cm. longa, 5—6 cm. lata; *supra* viridia, leviter canaliculata; *subtus* convexa, viridia; marginibus dentibus deltoideis rubris 2—3 mm. longis, 7—10 mm. distantibus munita.

Inflorescentia saepe 1-ramosa, c. 50 cm. alta. *Racemi* corymbosocapitati, c. 4 cm. longi, 9 cm. diam. *Bracteae* ovato-acutae, 5 mm. longae, 4 mm. latae, 3-nervatae. *Pedicelli* 30 mm. longi. *Perianthium* aurantiacum, cylindrico-clavatum, 27 mm. longum, circa ovarium 5—6 mm. diametro, hinc trigono-ampliatum; *segmenta exteriora* per 13 mm. libera. *Antherae* 0—1 mm. exsertae. *Stigma* demum 1 mm. exsertum. *Ovarium* viridulum 6 mm. longum, 2·5 mm. diam.

Madagascar. Fianarantsoa Province, on granite rocks 30 km NW of Fianarantsoa, coll. Mr. Gerard Fievet, cult. Mbabane, Swaziland, fl. 1 June 1965, Reynolds 11620 (Rauh 10332) holotype (PRE), isotype (K, P, TAN).

Our new species is named after Mr. Gerard Fievet who discovered plants on granite rocks 30 km. NW of Fianarantsoa near the village Andomaranomaitso (meaning "green water") at an elevation of 1200 m., with plants of *A. haworthioides* Bak., and the showy *A. capitata* Bak. var. *quartziticola* H. Perr. growing nearby.

It seems that *A. fievetii* is nearest allied to the typical form of *A. capitata* from which it differs in being a smaller plant with comparatively narrower channelled leaves, and in having a much lower (50 cm.) inflorescence which is mostly only 1-branched; the perianth is nearer slightly clavate than campanulate, while the outer segments are free only to the middle—not to base as in *A. capitata*. Anthers and stigma are exceedingly shortly exserted. The flowers of *A. fievetii* open from the bottom of racemes upwards—not from the apex downwards as occurs in *A. capitata*.

Description: *Plants* acaulescent or with short stem, mostly solitary.

Leaves 12—16, densely rosulate, spreading, narrowly lanceolate-attenuate, averaging 35 cm. long, 5—6 cm. broad at base; *upper surface* unicoloured-green with slight reddish tinge, flat low down, concave to canaliculate upwards;

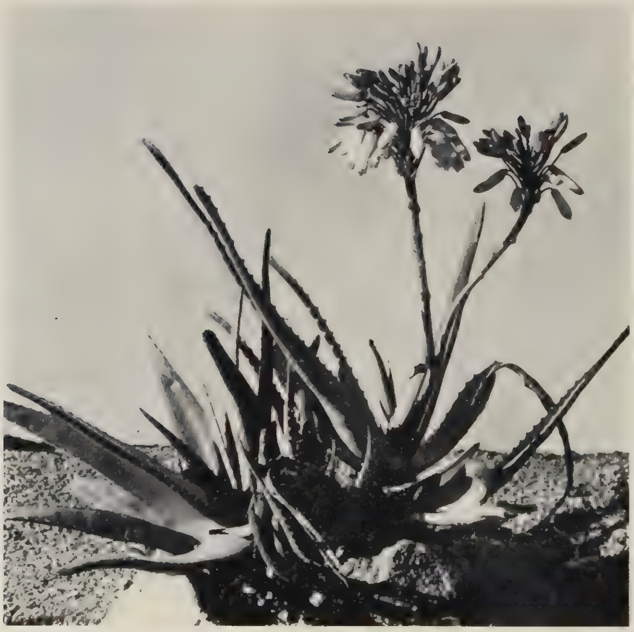

PLATE XLIV

Aloe fievetii Reynolds

Plant from 25 km. NW of Fianarantsoa, Madagascar, flowering at Mbabane, Swaziland. Height 50 cm.

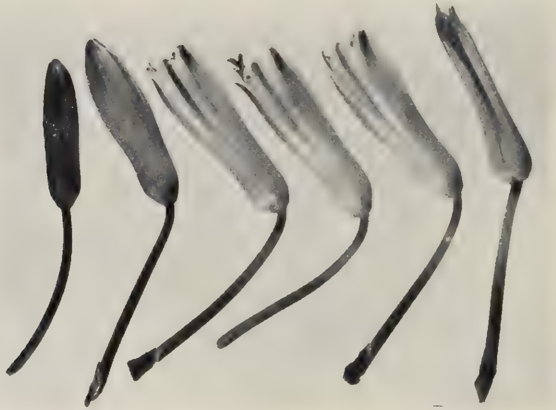

PLATE XLV

Aloe fievetii Reynolds

Buds and flowers 1/1

lower surface convex, green with slight reddish tinge in upper half; *margins* with a reddish-pink edge armed with deltoid teeth of the same colour, that are 2—3 mm. long, 7—10 mm. apart low down, smaller and more distant upwards, the leaf apex slightly twisted to the left, shortly rounded and with 3—4 very small teeth.

Inflorescence simple or 1-branched, up to 50 cm. tall.

Peduncle basally plano-convex and 16 mm. broad.

Raceme corymbose-capitate, densely many-flowered, about 9 cm. across, the pedicellate portion 4 cm. long, the buds dull scarlet, suberect, open flowers orange-yellow, nutant to subpendulous.

Bracts ovate-acute, brownish-red with membranous edge, 5 mm. long, 5 mm. broad at base, 3-nerved.

Pedicels 30 mm. long, the youngest suberect and straighter, the lowest more oblique and nutant at apex.

Perianth orange, cylindric slightly clavate, 27—30 mm. long, basally obtusely obconic, cylindric and 5—6 mm. diam. across the ovary, thence enlarging trigonously to a wide open mouth; *outer segments* free to the middle (14 mm.) with 3 greenish nerves; *inner segments* themselves free but dorsally adnate to the outer to the middle, broader than the outer and with a prominent greenish median nerve, the apices more obtuse.

Filaments very pale-yellow, the 3 inner narrower and lengthening before the 3 outer with their *anthers* in turn exserted 0—1 mm. *Stigma* at length exserted 1 mm.

Ovary green, 6 mm. long, 2·5 mm. diam.

A. cryptoflora Reynolds. Species nova, affinis *A. conifera* H. Perr. floribus sessilibus, sed foliis laete viridibus nec glaucescentibus differt; affinis *A. fievetii* Reynolds foliis viridibus, sed floribus brevioribus sessilibus differt.

Planta succulenta, acaulis vel breviter caulescens. *Folia* c. 15—20, dense rosulata, lanceolato-attenuata, 20—25 cm. longa, basi 6 cm. lata; *supra* planiuscula, viridia, immaculata; *subtus* convexa, viridia; marginibus linea cartilaginea rubra dentibusque deltoideis rubris 2—3 mm. longis, 5—10 mm. distantibus munita.

Inflorescentia simplex vel 1-ramosa, 40 cm. (interdum 60 cm.) alta. *Racemi* cylindrico-conici, 14 cm. longi, 3 cm. diam., densissime multiflores. *Bracteae* dense imbricatae, late ovato-orbiculares, crassae, carnosae, 11 mm. longae, 12 mm. latae, 7—9-nervatae. *Pedicelli* nulli. *Perianthium* sessile, cylindrico-campanulatum, levissime trigonum, luteum, 10 mm. longum; *segmenta exteriora* libera, 3—5-nervata. *Antherae* per 2—3 mm. exsertae. *Stigma* demum 3 mm. exsertum. *Ovarium* viridulum, 4 mm. longum, 2 mm. diametro.

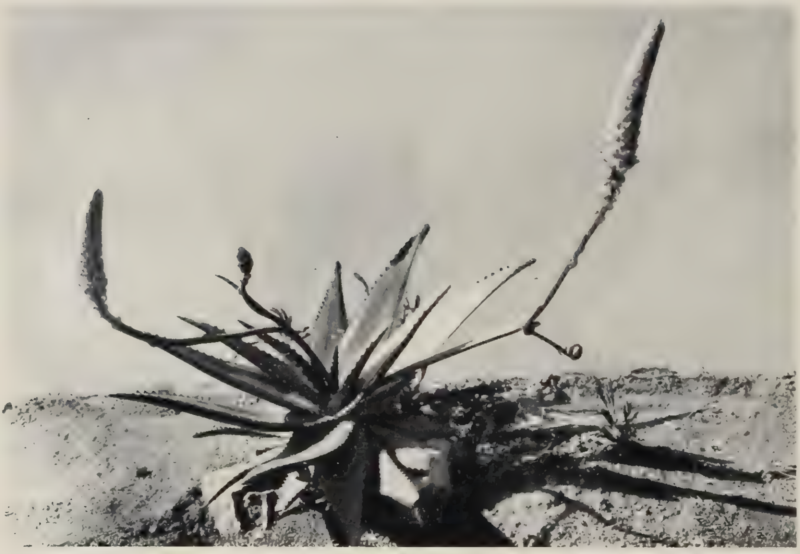

PLATE XLVI

Aloe cryptoflora Reynolds

Plant from 25 km. NW of Fianarantsoa, Madagascar, flowering at Mbabane, Swaziland. Height 55 cm.

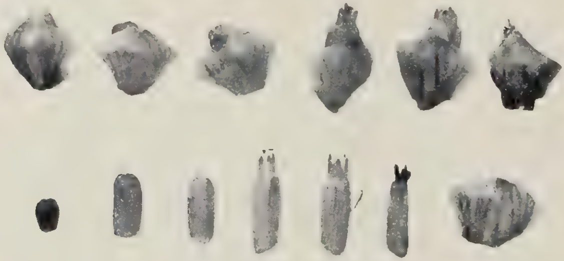

PLATE XLVII

Aloe cryptoflora Reynolds

Upper: Buds and flowers 1/1 hidden by their bracts.
Lower: Buds and flowers 1/1 with bracts removed; bract 1/1 at night.

MADAGASCAR. Fianarantsoa Prov., on granite 25 km. NW of Fianarantsoa, Alt. 1300 m., coll. G. Fievet, cult. Mbabane, Swaziland, fl. 10 June 1965, Reynolds 11619 holotype (PRE), isotype (K).

This remarkable species was discovered by Mr. Gerard Fievet of Fianarantsoa. Plants were sent by him to Mbabane, Swaziland, where some of them flowered in June 1965.

A. cryptoflora was so named because, when in full bloom, the flowers are hidden by their large fleshy somewhat rounded, as if cupped, bracts, only the mouth of the flower and the exserted orange anthers being visible.

In shape and size of the deep green leaves *A. cryptoflora* is nearest allied to *A. fievetii* but is nothing like it in floral characters. With its 10 mm.-long sessile flowers and densely flowered cylindric racemes (but not in leaves) *A. cryptoflora* is closely allied to *A. conifera* H. Perr. but the latter has a more compact rosette of bluish-grey leaves.

The bracts of *A. cryptoflora* are remarkably thick, fleshy, orbicular-cuspidate, and are somewhat cupped around the flower which it touches with the base, apex and margins of the bract. There is a distinct space between the middle of the bract and the perianth.

As is usual with racemes of this kind, the flowers open first up the sunny side of the raceme.

DESCRIPTION. *Plant* succulent, solitary, acaulous or with a short stem. *Leaves* 15—20, densely rosulate with slight spiral twist, lanceolate-attenuate, spreading, 20—25 cm. long, 6·5 cm. broad; *upper surface* deep-green with slight reddish tinge, rather flat, without spots or markings; *lower surface* convex, otherwise as the upper surface; *margins* with continuous brownish-red edge armed with teeth of the same colour that are deltoid, 2—3 mm. long, 5—10 mm. apart.

Inflorescence usually 1-branched, 40 cm. high, sometimes 60 cm. in the wild state.

Peduncle reddish-brown, basally plano-convex and 15 mm. broad, with one short branch from about the middle, with a few sterile-bracts above the base of the branch that are broadly ovate-cuspidate, thick and fleshy, the lowest about 12—15 mm. long and broad, 7—9-nerved.

Racemes cylindric, very slightly conic, the terminal 14 cm. long, 3 cm. diam., the lateral only half as long, very densely many-flowered, all buds at first hidden by densely imbricate bracts.

Bracts broadly ovate-orbicular-cuspidate, rounded and somewhat cupped, thick, fleshy, pale-green, 11 mm. long, 12 mm. broad when pressed flat, 7—9-nerved, the nerves greenish.

Pedicels none.

Perianth cylindric-campanulate, slightly trigonous, 10 mm. long, 3·5 mm. diam. across the ovary, greenish-yellow low down, orange-yellow at the mouth; *outer segments* free to base, obscurely 3—5-nerved; *inner segments* broader than the outer, with one median nerve.

Filaments lemon, the 3 inner narrower and lengthening before the 3 outer with their *anthers* in turn exserted 2—3 mm. *Stigma* at length exserted 3 mm. *Ovary* pale-green, 4 mm. long, 2 mm. diam.

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STUDIES IN CYPERACEAE IN SOUTHERN AFRICA: II

Review of the tribe Scirpeae and History of the genus *Fimbristylis* Vahl

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ABSTRACT

The tribe Scirpeae is reviewed with particular reference to interpretation of floral structure as simple, or specialised, within Cyperaceae. A plea for classification based on more attributes than have been employed in the past, is made. A history of the genus *Fimbristylis* Vahl is given.

INTRODUCTION

It has been accepted by many that Cyperaceae is a family allied to, but less highly advanced than, Gramineae together with which it has possibly been derived by parallel evolution from Liliaceous ancestors through the Juncaceous complex (Hutchinson, 1959).

Within Cyperaceae classification is by no means uniform, but it is generally accepted that there are a number of main spikelet and flower forms represented. These structural lines have been accorded tribal rank by the majority of workers. Thus Bentham (1887) recognised six such units, Holttum (1948) five and Hutchinson (l.c.) seven.

It has also been common practice to group the tribes into categories of higher hierarchal level in order to represent what have been regarded as the main lines of evolutionary development. Within these, by the positioning of the tribes, possible phylogenetic relationships were suggested. Thus Bentham (l.c.) grouped his six tribes into two series, Monoclines and Diclines. Clarke (1908) recognised four sub-orders, within the first of which, Scirpo-Schoeneae, he placed four tribes, one of which was Scirpeae. Mattfeld (1936) recognised three sub-families, while Hutchinson (l.c.) by failure to recognise such rank, indicated his seven tribes as representing distinct evolutionary lines.

Inherent in much of this classification has been the concept that the unisexual floret, such as occurs in *Carex*, is specialised and derived by reduction from bisexual flowers such as typify *Scirpus*.

On this basis the tribe Scirpeae, or the sub-family Scirpoideae, has been often regarded as the most primitive floral condition within Cyperaceae and representative of the probable stock from which other spikelet and flower forms were derived.

Comparatively recently, however, chiefly as the outcome of investigation of tropical genera by a number of workers, considerable doubt has been cast on this interpretation of relationships within the family. Mattfeld, (1938) who based his observations on *Dulichium* Pers., was probably the first to discuss the derivation of bisexual from unisexual flowers.

Subsequently Blaser, (1940) who attempted an interpretation of cyperaceous phylogeny based on the nature of the vascular supply to both spikelet and inflorescence, obtained evidence which suggested that, "the taxonomic spikelets of the Scirpineae and Lipocarphineae (following Pax, 1889) are, morphologically, contracted major branches, so that each flower represents a 'spikelet'." Thus he, too, could not support the interpretation of the scirpaceous spikelet as "simple".

Holttum (1948) reaffirmed Bentham's (1877) views regarding homology between the spikelets of Hypolytreae and *Scirpus* and went on to suggest derivation of the latter from the former by reduction; an hypothesis in keeping with the tropical forest environment favoured by most representatives of Hypolytreae. Holttum did not, however, pursue his thesis throughout Cyperaceae, for he proceeded to suggest development of the varied genera comprising Rhynchosporeae along a series of different lines all from the bisexual state in *Scirpus*. From the Rhynchosporeae he derived, again by reduction, the unisexual tribes Cryptangieae, Sclerieae and Cariceae, thus following, in part, the old concept of development of unisexual from bisexual floral types.

To this part of Holttum's paper Kern (1962) has raised serious objections, at the same time enthusiastically supporting the Mattfeld–Holttum concept of the possible development within Cyperaceae of bisexual from unisexual flowers. Kern goes as far as to maintain that if floral structure among the sedges is considered from this more recently proposed aspect, the family becomes so natural a unit that, "subdivision into sub-families is hardly, if at all, justified". He also avers that if the newer interpretation is proved correct, "a derivation (of Cyperaceae) from Liliiflorae, especially Juncaceae, is impossible."

Such diametrically opposed interpretations of evolutionary development must surely prove a stimulus to modern workers within the family. Especially must this be the case for those in the tropics and in areas where undescribed species are likely to be encountered. Not only must observation of floral form by such workers be meticulously accurate, but interpretation must be undertaken with an open mind. More important still is the need to obtain data from aspects additional to that of floral form in order to provide a further appreciation of natural relationships, which will provide a broader basis for classification than that which pertains at present and from which, eventually, phylogenetic lines may possibly be more correctly deduced.

In studying Southern African Cyperaceae, the tribe Scirpeae, because of its controversial evolutionary position and numerous representatives, was considered a good starting point.

REVIEW OF THE TRIBE SCIRPEAE

The tribe Scirpeae can be said to include all sedges with an apparently simple spikelet construction consisting of a central rachilla bearing an indefinite number of spirally, or partly distichously, arranged glumes each of which carries in its axil a single hermaphrodite flower. Occasional exceptions occur when the basal one or two glumes of a spikelet are sterile. Towards the apex of the spikelet the florets of the uppermost glumes, probably as the result of lack of vigour, sometimes fail to produce stamens and so appear unisexual.

Despite this rather clear cut definition, it is perhaps not surprising in view of opposed morphological interpretations of the scirpaceous spikelet, to find that the limits of the tribe differ from one author to another, depending partly upon the morphological interpretation followed and partly upon the emphasis given to characters used in classification.

In treating South African Cyperaceae, Clarke (1898) and following him Phillips, (1926) include *Lipocarpha* R. Br. and *Ascolepis* Steud. within Scirpeae. On the other hand Schonland, (1922) probably following Pax (1889), excludes these taxa, and includes only *Scirpus* L., *Eleocharis* R. Br., *Fimbristylis* Vahl, *Bulbostylis* Kunth, *Ficinia* Schrad. and *Fuirena* Rottb.

These are the genera most commonly included in the tribe, but there is no guarantee of the correctness of the relationships implied by such classification. Already there is doubt regarding the inclusion of *Fuirena* in this plexus, for Kern (1962) has stated that from his observations, which he points out need the corroboration of evidence from anatomical investigation, the scales are within rather than without, the stamens.

Confirmation of Kern's observation is not afforded by the work of Blaser, (1941) who investigated by serial sectioning development of vascular supply and floral organs in *Fuirena hispida* Ell.

It is unwise, however, to be definite on evidence derived from study of a single species only. Examination of all representative types within the genus is essential before Kern's observations can be disregarded. If they prove correct, then the affinities of *Fuirena* must be reconsidered, for they probably do not lie with Scirpeae.

Other genera of this tribe need re-consideration. Kern (l.c.) suggests the disc under the nut in *Scleria* might perhaps be, not a vestigial perianth, but a utricle, homologous with that of *Bisboeckelera* O. Ktze. What of the disc in *Ficinia* that is sometimes poorly developed in some species of *Scirpus*? *Scirpus* itself needs further detailed study, for generic limits are not clearly defined nor stable, and in the course of its history transference of many species within and without the taxon, sometimes without fundamental morphological supporting evidence, has taken place.

The difficulty in defining limits to *Scirpus* applies again with other genera. Species of *Fimbristylis* are difficult to differentiate from *Bulbostylis* species; *Eleocharis* from *Scirpus; Ficinia* from *Fimbristylis* and *Scirpus.*

Clearly a new approach is necessary. The characters upon which classification has been based in the past are unsatisfactory, being in particular too few. Thus the distinction between *Bulbostylis* and *Fimbristylis* really depends only upon the persistence, or not, of the style base on the achene. What of species in which the style base persists for a short period only, to fall eventually?

Classification on the basis of as many attributes as possible must be carried out if a clearer understanding of relationships within the family is to be gained. At present, modifications must of necessity be based predominantly on morphological characters, vegetative and floral, since information from other aspects of study is largely lacking.

The little work that has so far been carried out on the chromosomes of Indian and African species suggests that this aspect of study may add valuable information to that derived from morphology, for Sharma and Bal (1956) found the chromosome type in *Fimbristylis* to differ from that in *Scirpus.* On these grounds they advocated the removal of one or other genus from Scirpeae. Such radical changes cannot be undertaken until a body of knowledge from many different aspects of study is available for integration and consideration. Nor must radical changes be undertaken until knowledge of species on a world basis is available. To this end, detailed investigation by individual workers in different areas can contribute materially to the whole appreciation of relationships within Cyperaceae.

As a starting point within Scirpeae investigation of *Fimbristylis* was commenced. This genus was selected since its limits, apart from relationship with *Bulbostylis*, are fairly clearly defined. In addition some of its species are pantropic in distribution and therefore of significance to others outside Africa. Lastly its morphological structure seemed reasonably constant.

HISTORY OF THE GENUS **FIMBRISTYLIS** VAHL

Type species: *F. dichotoma* (L.) Vahl

The genus *Fimbristylis* was first established by Vahl (1806) who gave this name to a taxon he characterised by the brief description, "Squamae palaeaceae undique imbricatae. Cor. O. Stylus 2-fidus, basi bulbosus, compressus, margine ciliatus. Set. O."

The genus should thus, according to Vahl, accomodate only species with all glumes imbricate and with compressed, ciliate margined, basally expanded two-branched styles. No mention was made of achene nor of inflorescence form, but in the light of present knowledge, it is safe to assume that the type species having two-branched styles, also had lenticular nuts. The inflorescence must have been compound, of "umbellate" form, comprising approximately from twenty to one hundred laxly arranged spikelets.

Fimbristylis was thus, as originally defined, a homogeneous "natural" taxon. Species exhibiting this basic structure except for slight, apparently constant differences were regarded as representing distinct, yet closely allied genera.

Thus about the time at which Vahl described *Fimbristylis*, the following taxa were also established.

Abildgaardia Vahl (1806)—basal glumes to spikelet distichous, not spiral;
Isolepis R. Br. (1810)—inflorescence of one spikelet only;
Trichelostylis Lestib. (1819)—style 3-branched; nut 3-angled;
Pogonostylis Bertol. (1833)—style base with long pendant hairs overhanging nut.

In the latter half of the nineteenth century, with acceptance of the evolutionary outlook and the possibility of natural variation within species, established generic limits were scrutinised to determine whether these might be regarded as of phylogenetic significance, or whether they were of purely systematic value and so "artificial".

This scrutiny resulted in eventual sinking in *Fimbristylis* of all the genera mentioned above, as well as of others. Boeckeler, (1869–1870) who was finally responsible for appreciating the artificiality of R. Brown's *Isolepis*, included all *Isolepis* names known to him in other genera of Cyperaceae. Thus the four hundred and seventy synonyms established in *Isolepis* were referred to eighteen genera, the vast majority to *Scirpus*, but sixty-two to *Fimbristylis* (Beetle, 1945).

Thus during the first one hundred and fifty years of its history, the limits applied to *Fimbristylis* by Vahl were widened until, today, species with partially distichous, partially imbricate glumes; with three-branched styles and trigonous achenes; with long hairs pendant from the style base and partially masking the nut; with inflorescences of solitary spikelets terminal on the flowering stems are all included by the majority of systematists. Whether this interpretation will be maintained in the light of modern cytotaxonomic work and evidence from other fields of study will be interesting to determine. There are, of course, still the workers who maintain some of these "genera". Thus Robyns and Tournay (1955) maintain *Abildgaardia*, including in it *A. monostachya* (L.) Vahl = [*F. monostachya* (L.) Hassk.]

Pax (1889) recognised five sections within Fimbristylis, namely:

Heleocharoides (=genus *Mischospora* Boeck.)—spikelets solitary on the flowering stem;

Abildgaardia —Vahl's genus of this name (=*Gussonea* Presl.);
Dichelostylis —the original type form of the genus;
Pogonostylis —Bertoloni's genus of this name;
Trichelostylis —Lestiboudois' genus of this name.

Pax noted that *Fimbristylis* Vahl also included *Echinolytrum* Desvaux, although he gave no indication of the section to which this should belong.

The most recent treatments of the genus are those by Ohwi (1938) and Kern (1955) both of which agree in outline. Kern, who "attempted to trace all sectional names available and to typify them in such a way that the old names can be maintained," has recognised eighteen sections amongst the Malaysian species alone, including the five enumerated by Pax. Kern stated that the limits of his sub-genera are far from well marked and that, "a system not based on the thorough knowledge of all species of the genus will inevitably show shortcomings in many respects." His sections that carry old names generally en-

TABLE I

Fimbristylis species enumerated for South Africa (Clarke, 1898) and for Southern Africa. (Gordon–Gray, 1964) arranged in sections following Pax (1889) and Kern (1955)

Section, following Pax (1889)	Southern African species as enumerated by Clarke (1898)	Southern African species according to Gordon–Gray (1964)	Section, following Kern (1955)
Abildgaardia	F. monostachya	F. monostachyos F. triflora F. hygrophila, sp. nov.	Abildgaardia
		F. variegata, sp. nov.	Fuscae
Dichelostylis	F. ferruginea	F. ferruginea	Dichelostylis
		F. longiculmis	
	(F. diphylla) =	F. dichotoma	Fimbristylis
	(F. dichotoma) =	F. bis-umbellata	
	F. squarrosa	F. squarrosa	Pogonostylis
Trichelostylis	F. complanata	F. complanata	Trichelostylis
		F. microcarya	
	F. obtusifolia	F. obtusifolia	Cymosae
		F. aphylla	Miliaceae
	(F. exilis) =	F. hispidula	Leptocladae

compass a narrower concept than that originally accepted by the authors of these names.

Clarke (1898) referred eight South African species to *Fimbristylis*, and following Pax's classification, placed four of these in the section Dichelostylis, three in Trichelostylis and one in Abildgaardia. It is difficult to understand why he preferred to place *F. squarrosa* Vahl in Dichelostylis rather than in Pogonostylis.

Fourteen species within *Fimbristylis* have been recorded for Southern Africa by the present author. The sectional arrangement of these following Pax and Kern is shown in Table 1.

It remains to be seen in how far such classification will have to be modified in the light of information from fields other than morphology, particularly when such evidence can be integrated with similar information for world species.

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ANATOMIE VAN DIE STINGELS VAN *PROTEA REPENS* (L.) L. EN *LEUCADENDRON ADSCENDENS* R. BR. I. BOU EN DIFFERENSIASIE VAN DIE GROEIPUNTE*

Carina Visser

ABSTRACT

The structure of the stem growing points of *Protea repens* (L.) L. non Thunb. and *Leucadendron adscendens* R. Br., and the differentiation of the primary tissues beneath it were investigated and compared. In the apical meristem are a two-layered tunica and a corpus. The following cytohistological zones are present: a central zone, a peripheral zone and a ribmeristem. Differentiation of the cortex, pith and procambium was investigated. The procambial strands as well as the primary phloem within it differentiate acropetally, while the primary xylem differentiates acropetally and basipetally from the leaf bases.

Inleiding

Oor die vegetatiewe anatomie van die Proteaceae is nog min navorsing gedoen, terwyl dít wat wel gedoen is, hoofsaaklik van Australiese soorte is. In die beskikbare literatuur kon slegs gegewens gevind word oor die blaaranatomie en algemene stingelanatomie. Oor die bou van die groeipunte en die differensiasie van weefsels in en onder die groeipunte kon geen gegewens gevind word nie. In die huidige ondersoek is 'n poging aangewend om die leemtes in hierdie verband aan te vul.

Materiaal en Metodes

Twee soorte van die Proteaceae is vir die ondersoek gebruik, nl. *Protea repens* (L.) L. non Thunb. (P. mellifera Thunb.) en *Leucadendron adscendens* R. Br. Die materiaal van albei soorte is in die Jan Marais-park op Stellenbosch versamel.

Versamelings is ongeveer elke twee maande oor 'n tydperk van een jaar gemaak. Gedurende die begin van die groeiseisoen is versamelings meer gereeld gemaak, nl. ongeveer elke maand.

Vir die ondersoek van die stingelgroeipunte is okselknoppe en eindknoppe gebruik. Verskeie metodes van fiksering en kleuring is getoets en gekombineer om die beste resultate met die betrokke materiaal te verkry. Dit het geblyk dat FAA die beste fikseermiddel is. Vir die dehidrasie en infiltrasie in paraffienwas is etielalkohol en chloroform gebruik. Mikrotoomsneë met 'n dikte van 10—12μ is gemaak. Delafield se haematoksilien alleen, of in kombinasie met safranien, is algemeen gebruik vir die kleuring van die sneë. Tekeninge is gemaak met 'n Zeiss Promar-tekenapparaat.

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ONDERSOEK

Stingels van 'n aantal plante van bogenoemde soorte is dwarsdeur die jaar ondersoek wat uitwendige morfologiese kenmerke en groeitye betref.

Die eindknoppe van beide soorte is hoofsaaklik verantwoordelik vir die vorming van bloeiwyses, terwyl een of meer van die okselknoppe onder die eindknop stingelverlenging veroorsaak. In sommige gevalle sorg die eindknop egter vir stingelverlenging, terwyl die okselknoppe dan rustend bly.

Die groeipunte van *Protea repens* was rustend wat stingelverlenging betref gedurende Januarie tot Mei, en aktiefgroeiend vanaf Junie tot Desember. Die stingeltoppe van *Leucadendron adscendens* was rustend gedurende April tot Oktober, en het verleng vanaf November tot April.

1. **Bou van die groeipunte** (figure 1—2)

Die stingelgroeipunte van *P. repens* en *L. adscendens* stem in hoofsaak ooreen in bou.

Aard, vorm en grootte van die groeipunte (fig. 1). By beide soorte is die apikale meristeem redelik groot, sterk koepelvormig en effens verhef bokant die jongste blaarprimordia. Die aktiefgroeiende stingeltop word omring deur talle jong loofblaartjies, terwyl die rustende knop omring is deur 'n aantal klein skubblaartjies.

Direk onder die apikale meristeem is nog geen litte aanwesig nie en die blaarprimordia, wat spiraalsgewys ontstaan, is dig opmekaar gerangskik. Litverlenging vind eers plaas onderkant die vyfde tot sesde blare van 'n ortostichie. Die stingelprotodermis is eers in hierdie eerste litte waarneembaar. Die eerste okselknopprimordia kom voor in die oksels van die sesde of sewende blare van die ortostichie. Hulle ontstaan dus uit gedeeltelik gedifferensieerde weefsel van die litte.

Primêre verdikking vind baie vroeg plaas—net ná of tydens die aanleg van die blaarprimordia. Daarom sit 'n aantal blaarprimordia op die skuinste, naasteby langs mekaar (fig. 1).

Die vorm van die apikale meristeem bly koepelvormig gedurende die plastochron, maar toon die tipiese grootteveranderings soos dikwels in die literatuur beskryf. In die maksimale area-fase, d.w.s. aan die einde van die plastochron en net voor die vorming van 'n nuwe blaar, is dit hoër en breër. Nadat die jongste blaarprimordium ontstaan het, d.w.s. aan die begin van die plastochron, is dit effens smaller en platter (d.i. minimale area-fase).

By die aktiewe groeipunte van *P. repens* varieer die grootte van die apikale meristeem van 200—318μ breed (gemeet by die basis) en 55—88μ hoog aan die

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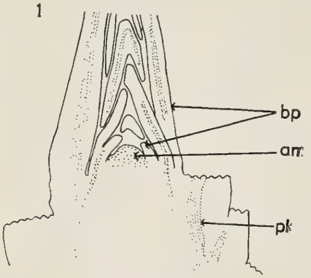

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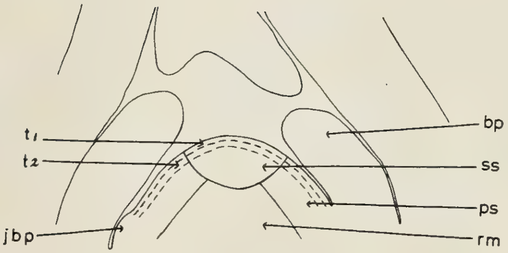

FIG. 1.
Diagram van 'n mediane lengtesnee deur die stingelgroeipunt van *Protea repens*, × 23; am, apikale meristeem; bp, blaarprimordia; pk, prokambium.

FIG. 2.
Sitohistologiese sones in 'n mediane lengtesnee deur die apikale meristeem van *Protea repens*, × 125; bp, blaarprimordium; jbp, jongste blaarprimordium; ps, perifere meristeem; rm, ribmeristeem; ss, sentrale sone; t1, buitenste tunicalagie; t2, binneste tunicalagie.

begin van 'n plastochron, tot 253—374μ breed en 83—132μ hoog aan die einde van 'n plastochron. By rustende knoppe van *P. repens* varieer die grootte van 220—270μ breed en 77—110μ hoog aan die begin, tot 260—330μ by 88—143μ aan die einde van 'n plastochron. By *L. adscendens* varieer die grootte van 150—172μ breed en 66—77μ hoog in die maksimale tot 117—143μ by 44—58μ in die minimale area-fase.

Die breedte van die apikale meristeem is op mediane lengtesneë gemeet tussen die oksels van die twee jongste herkenbare blaarprimordia. Die hoogte is gemeet vanaf hierdie lyn tot by die hoogste punt van die apikale meristeem. Dit is die metode wat o.a. deur Rouffa en Gunckel (1951) en deur Popham en Chan (1950) gevolg is.

Uit bogenoemde afmetings kan gesien word dat die apikale meristeem van *P. repens* bietjie groter is as dié van *L. adscendens.*

Delingsfigure van mitose is waargeneem in aktiefgroeiende stingeltoppe van *P. repens* wat van Junie tot Desember versamel is. Hierdie seldelings is 'n bewys van die aktiwiteit van die apikale meristeem. Geen delingsfigure is egter waargeneem in groeipunte van *L. adscendens* nie.

Tunica en corpus (fig. 2). In 'n mediane lengtesnee het die apikale meristeem van beide soorte 'n gelaagde voorkoms. Indien die delingsvlakke van die selle in ag geneem word, kan 'n tunica en corpus daar onderskei word (fig. 2).

In die huidige ondersoek is die apikale meristeem beskou as slegs daardie gedeelte van die stingeltop tussen en bokant die twee jongste blaarprimordia, aangesien die selpatroon versteur word deur die vorming van die blaarprimordia (vgl. Schmidt, 1924). Die tunica is beskou as daardie oppervlakkige sellae waarin slegs antiklinale delings plaasvind (Clowes, 1961).

By beide *P. repens* en *L. adscendens* is twee tunicalae aanwesig, nl. t1 en t2, waar t1 die buitenste en t2 die binneste tunicalagie is. Bokant die punte van blaarinisiasie deel die tunicaselle slegs antiklinaal. Waar die jong blare gevorm word, deel selle van t2 ook periklinaal en skuins, nes die buitenste paar sellagies van die corpus, om daar 'n bultjie van meristematiese selle, die blaarprimordium, te vorm. Die aantal tunicalae bly konstant gedurende die plastochron, asook gedurende die verskillende jaargetye.

Die selle van die tunica is redelik klein, ongeveer reghoekig, min gevakuoleer en besit groot kerne. Die selwande tussen dogterselle wat pas gedeel het, is effens dunner as die ouer wande. Die sentraal geleë tunicaselle is effens groter en neem minder kleurstof op (is dus meer gevakuoleer) as dié aan die kante.

Onder die tunica kom die corpus voor wat die grootste deel uitmaak van die apikale meristeem. In die derde laag vanaf die oppervlakte vind meesal antiklinale, maar soms ook periklinale delings plaas. Dus behoort hierdie laag reeds tot die corpus, volgens Clowes se definisie van die tunica. In die corpus vind verder antiklinale, periklinale en skuins delings plaas, om sodoende nuwe selle by die corpus by te voeg, namate die corpusselle aan die onderkant differensieer tot volwasse selle van die stingel.

Die selle van die corpus lyk nie almal eners nie en verskil van mekaar t.o.v. selgrootte, selvorm, mate van vakuolering (en dus kleurbaarheid), selwanddikte en delingsvlak. Daarom kan in die corpus verskillende sones onderskei word.

Sitohistologiese sones (fig. 2). In 'n mediane lengtesnee van die stingeltoppe kan drie sitohistologiese sones onderskei word by beide soorte. Die grense van die sones is nie skerp nie, want die volgende eienskappe word gebruik om die indeling te maak: selgrootte, selvorm, relatiewe dikte van selwande, mate van vakuolering, affiniteit van die selle vir kleurstof, delingsvlak, posisie van die selle.

Wat betref die indeling van die apikale meristeem in sitohistologiese sones word in die literatuur twee groepe werkers aangetref, nl. 'n groep (o.a. Popham 1951, Gifford 1954, Boke 1941, Reeve 1942) wat die tunica as 'n afsonderlike sone beskou. Ander werkers (o.a. Philipson 1954, Majumdar 1942, Millington en Gunckel 1950) ignoreer die gelaagdheid van die top wanneer hul die apikale meristeem in sones indeel. In die huidige ondersoek word laasgenoemde opvatting gehuldig, aangesien die tunica hier, op grond van ander faktore as net die delingsvlak, nie as 'n afsonderlike sone te onderskei is nie.

(i) *Die sentrale sone* is redelik groot en is sentraal en oppervlakkig geleë. Dit sluit die sentraal geleë deel van die tunica, sowel as die sentrale en hoogste deel van die corpus in.

Die selle van hierdie sone is groter as dié van die perifere sone en meer isodiametries. Hulle is ligter gekleur en dus meer gevakuoleer as in die perifere sone. Geen delingsfigure is hier te sien nie, maar die konfigurasies van selle suggereer dat delings wel hier plaasvind, antiklinaal in die twee buitenste sellae en in alle rigtings in die dieper lae.

(ii) *Die perifere sone* kom voor as 'n oppervlakkige silinder aan die kante van, en skuins onderkant die sentrale sone. Dit is ongeveer agt tot tien sellae diep. Aan die buitekant van die sone kom die twee tunicalagies voor en dieper (na binne) is corpusselle. Seldelings vind antiklinaal plaas in die tunica en in alle vlakke in die corpus. Die selle is klein, met groot kerne en is min gevakuoleer.

Die tunicaselle van hierdie sone is kleiner, meer vierkantig van vorm, minder gevakuoleer en die groot kerne is donkerder gekleur as die tunicaselle wat deel uitmaak van die sentrale sone.

Uit die perifere sone ontstaan die blaarprimordia asook later die epidermis, skors en prokambium. Die epidermis ontstaan uit t1 en die skors uit t2 en die buitenste corpusselle. Die prokambium ontstaan uit die binneste corpusselle van hierdie sone deur lengtedelings, waardeur lang, smal, protoplasmaryke selle gevorm word.

(iii) *Die ribmeristeem* is die sentraal geleë massa selle onder die sentrale en binne die perifere sones, en bestaan uit die grootste, laer gedeelte van die corpus.

Die selle is relatief groot, isodiametries, baie gevakuoleer en met effens verdikte wande. Seldelings vind hier in alle vlakke plaas maar verminder

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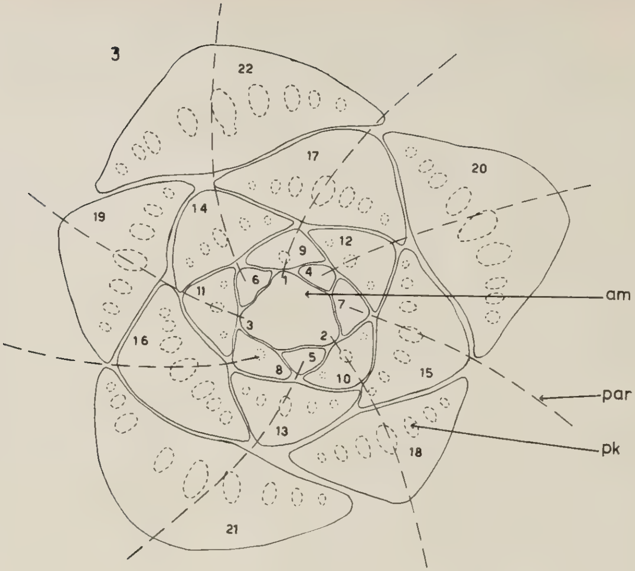

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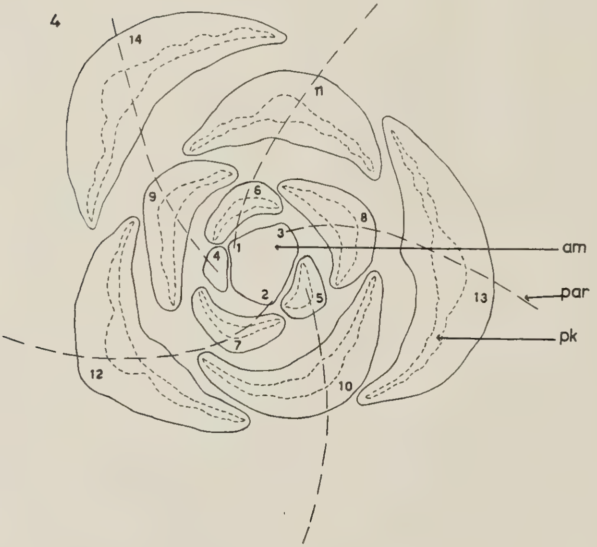

FIG. 3.

Fillotaksie van *Protea repens*, × 44.

FIG.4.

Fillotaksie van *Leucadendron adscendens*, × 98; am, apikale meristeem; par, parastichie; pk, prokambium.

geleidelik ondertoe, terwyl vakuolering toeneem na onder. Deur lengte- en skuins delings van sommige van die selle vermeerder die aantal vertikale selrye, sodat die stingel breër word. Primêre diktegroei geskied, m.a.w. deur lengtedelings in selle van die ribmeristeem. Baie dwarsdelings vind ook plaas in die vertikale selrye, en groepies dogterselle wat uit aparte moederselle ontstaan het, is te sien. Hierdie selgroepies word nie meer omring deur die oorspronklike moederselwand soos Ball (1949) by *Lupinus albus* gevind het nie. Die buitewande van so 'n selgroepie is wel dikker as die dwarswande tussen die dogterselle.

Die sitohistologiese sones is meer opvallend gedurende daardie maande wanneer die groeipunte redelik onaktief is. Sonasie stem ooreen by rustende en aktiewe groeipunte, behalwe dat die sentrale sone van laasgenoemde effens groter is as by rustende groeipunte.

2. **Differensiasie van primêre weefsels** (figure 3—8).

Die differensiasie van weefsels in en onder die groeipunte stem in hoofsaak ooreen by *P. repens* en *L. adscendens*.

Dwarssneereekse is gemaak vanaf die apikale meristeem ondertoe. Hieruit kon ook die blaarstand bepaal word, nl. $\frac{3}{8}$ fillotaksie vir *P. repens* (fig. 3) en $\frac{2}{5}$ vir *L. adscendens* (fig. 4).

Die apikale meristeem vertoon in 'n dwarssnee aanvanklik as 'n klein, ronde groep donker gekleurde, meristematiese selle. Blaarprimordia kom effens laer voor as bultjies aan die rand van die groep selle. Die deursnee van die apikale meristeem neem toe na onder a.g.v. seldeling en selvergroting daarin.

Vakuolering begin ongeveer 100—130μ en 70μ onder die top, by *P. repens* en *L. adscendens* onderskeidelik. Dit begin in die ribmeristeem (toekomstige murg) (fig. 5a) en neem geleidelik toe na onder. By rustende knoppe begin dit nader aan die apikale meristeem as by aktiewe groeipunte. Die eerste tannienbevattende murgselle kom ongeveer 190—230μ onder die top by *P. repens*, en 80μ by *L. adscendens* voor. Klein intersellulêre ruimtes kan ongeveer 210—230μ en 100—110μ onder die top by *P. repens* en *L. adscendens* onderskeidelik, onderskei word.

Vakuolering begin effens later in die perifere meristeem op die plek waar die toekomstige skors sal ontstaan, asook aan die abaksiale kante van die blaartjies. Terwyl vakuolering plaasvind, kom daar ook nog seldelings voor in die jong skors en murg.

'n Oorblywende meristeemring is nou te onderskei, 200—240μ onder die top by *P. repens* en 100—120μ by *L. adscendens*, op die grens tussen die toekomstige skors en murg (fig. 5b). Dit bestaan uit 'n ring van klein, ongevakuoleerde, donker gekleurde, meristematiese selle met groot kerne en dun selwande,

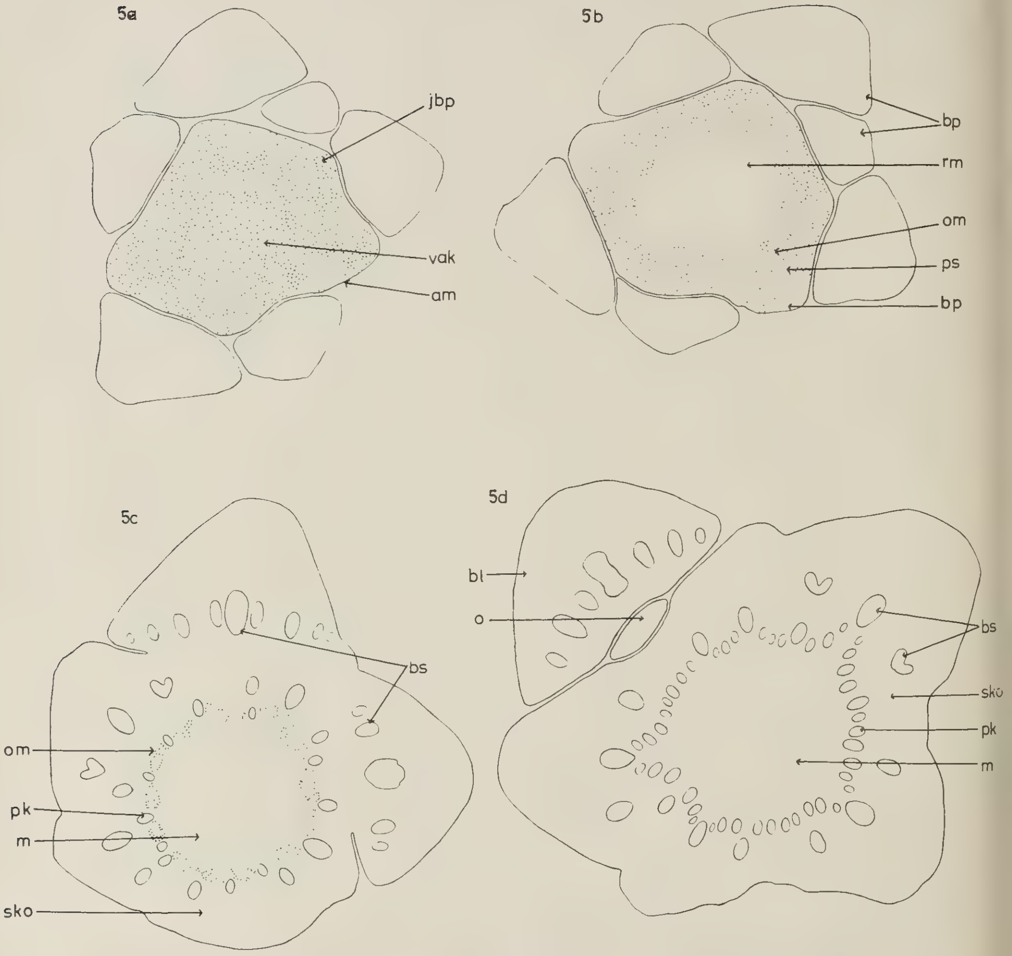

Fig. 5.
Dwarssneë deur 'n groeipunt van *Protea repens*, diagrammaties geteken. 5a. Eerste vakuolering geskied in die ribmeristeem (120μ onder die top), × 110. 5b. Die oorblywende meristeemring word afgebaken (160μ onder die top), × 60. 5c. Differensiasie van die eerste prokambiumstringe geskied (290μ onder die top), × 45. 5d. Differensiasie van die prokambiumstringe is voltooi (560μ onder die top), × 36; am, apikale meristeem; bl, blaar; bp, blaarprimordia; bs, blaarspore; jbp, jongste blaarprimordium; m, murg; o, okselknop; om, oorblywende meristeemring; pk, prokambiumstring; ps, perifere meristeem; rm, ribmeristeem; sko, skors; vak, vakuolering begin.

en is aaneenlopend met die apikale meristeem. In hierdie ring ontstaan die prokambiumstringe. Die meristeemring vorm geen afsonderlike ontwikkelingstadium nie, aangesien die prokambiumstringe terselfdertyd as die ring differensieer. Volgens Esau (1954) is hierdie die algemene toestand.

Die eerste prokambiumstringe word ongeveer 200—240μ vanaf die top by *P. repens* en 120—140μ by *L. adscendens* aangelê (fig. 5c). Aanvanklik deel net een van die selle van die oorblywende meristeem oorlangs om 'n prokambiumstring aan te lê. Die dogterselle deel weer herhaaldelik in die lengte, terwyl lengtedelings ook in die aangrensende selle plaasvind. Só ontstaan spoedig 'n klein groepie meristematiese selle wat duidelik van die ander meristematiese selle onderskeibaar is deur hul kleiner deursnee. Dit is die prokambiumstring (figure 5c, 6a).

Differensiasie van die prokambiumstringe vind akropetaal plaas. Naby die top is alleen 'n klein aantal prokambiumstringe en verder na onder meer. Hierdie stringe staan in direkte verband met die jong blaartjies en is dus blaarspore. Jonger prokambiumstringe ontstaan tussen die reeds bestaande stringe, sodat 'n dwarssnee stringe met verskillende grade van differensiasie en groottes toon. Die stringe neem toe in breedte deur lengtedelings van hul eie, sowel as van die aangrensende selle van die meristeemring.

Differensiasie begin in die groter prokambiumstringe ongeveer 230—270μ onder die top by *P. repens* en 160—190μ by *L. adscendens*, met die aanleg van 'n protofloëemelement in die buitenste gedeelte van die string (fig. 6b). Die eerste protofloëemelemente is van die ander selle in die string te onderskei deur effens dikker, donkerder gekleurde selwande en deurdat hulle min sitoplasma besit en dus leeg lyk. Differensiasie van die protofloëem geskied akropetaal.

Differensiasie van die protoxileem begin in die groter stringe ongeveer 250—300μ onder die top by *P. repens* en 180—260μ by *L. adscendens* (fig. 6c). Dit begin in die binneste gedeelte van die prokambiumstring, in 'n blaarbasis, en brei uit akropetaal in die blaar in, sowel as basipetaal in die stingel in, om aan te sluit by die laergeleë, reeds bestaande primêre xileem van die stingel. Differensiasie van die protoxileem in die blaarbasisse begin nadat die opwaarts differensiërende protofloëem die blaarbasisse bereik het. Geleidelik differensieer meer protoxileemelemente, totdat 'n klein groepie sulke elemente in die binnehelfte van die string voorkom. Die tracheale elemente van die protoxileem (vate en/of tracheïede) besit spiraalvormige wandverdikkings.

'n Epidermis met 'n dun kutikula is nou reeds aanwesig, maar nog geen huidmondjies nie.

Die jong skors en murg vergroot nog deur seldelings daarin. Geen endodermis kom voor nie. By *P. repens* word setmeelkorrels reeds ongeveer 0·75—1 mm

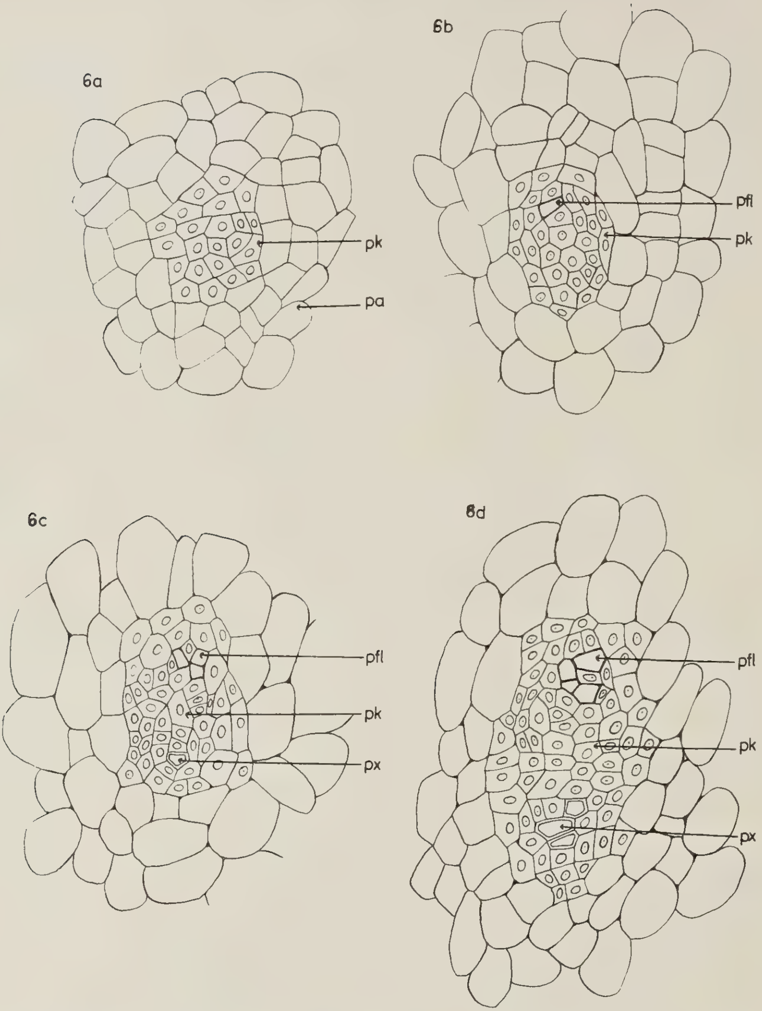

Fig. 6.

Opeenvolgende stadia van differensiasie in die prokambiumstringe by *Protea repens* (dwarssneë), × 460. 6a. 'n Prokambiumstring sonder enige differensiasie. 6b. Eerste protofloëemelement differensiëer. 6c. Eerste protoxileemelement differensiëer. 6d 'n Groepie protofloëem- en protoxileemelemente in die prokambiumstring; pa, aangrensende parenchiemselle; pfl, protofloëem; pk, prokambiumstring; px, protoxileem.

onder die top aangetref in die paar lae skorsselle net buite die jong vaatbundels. Hierdie selle vorm die setmeelskede. By *L. adscendens* word setmeelkorrels reeds ongeveer 0·75 mm onder die top, verspreid in die skors en murg, aangetref. Klein chloroplaste is hier reeds aanwesig in die skors maar nog geen steenselle of kristalle nie. Die skors en murg is hier alreeds ryk aan tannien, en sommige floëemelemente bevat ook al tannien.

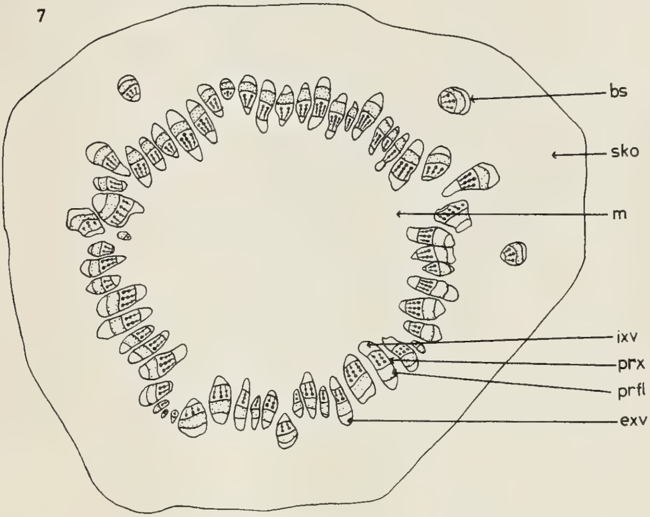

FIG. 7.

Dwarssnee van 'n jong stingel van *Protea repens*, diagrammaties geteken, × 18; bs, blaarspoor; exv, ekstraxilêre vesels; ixv, xilêre vesels; m, murg; prfl, primêre floëem; prx, primêre xileem; sko, skors.

Die grens tussen proto- en metafloëem is nie skerp nie. Die elemente van laasgenoemde is effens groter as dié van die protofloëem en toon 'n min of meer radiale rangskikking. In die primêre floëem is sifbuise, begeleidende selle en floëemparenchiem te onderskei. In die sifbuise kom saamgestelde sifplate voor waarop klein hoeveelhede kallose te onderskei is.

Terwyl die metafloëemelemente gevorm word, verloor die protofloëemsifbuise hul funksie. Die aangrensende parenchiemselle vergroot en druk die sifbuise en begeleidende selle inmekaar. Op hierdie stadium is die parenchiemselle nog lewendig en dunwandig, maar later verdik en verhout hul wande en word daaruit groepe primêre floëemvesels aan die buitekante van die vaat-

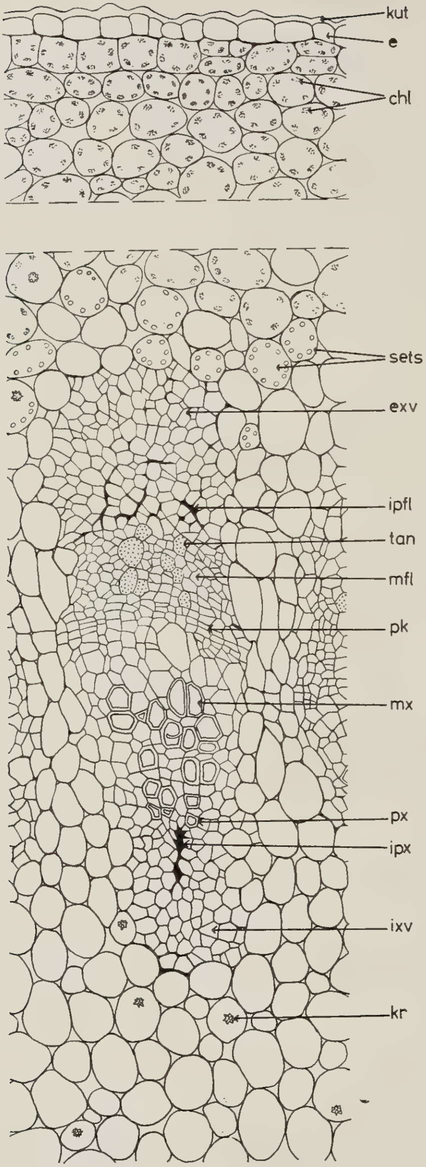

FIG. 8.

Detail van 'n sektor van fig. 7, × 190; chl, chloroplaste; e, epidermis; exv, ekstraxilêre vesels; ipfl, inmekaargedrukte protofloëem; ipx, inmekaargedrukte protoxileem; ixv, jong xilêre vesels; kr, kristal; ktu, kutikula; mfl, metafloëem; mx, metaxileem; pk, prokambium; px, protoxileem; sets, setmeelskede; tan, tannien.

bundels gevorm (ekstraxilêre vesels). Tussen hierdie jong veselselle is inmekaargedrukte protofloëemelemente te onderskei as verdikte selwandgedeeltes (fig. 8).

Daar is ook nie 'n skerp grens tussen die proto- en metaxileem nie. Metaxileemelemente word ongeveer 800—900μ en 630—850μ onder die top by *P. repens* en *L. adscendens* onderskeidelik, aangetref. Hulle is effens groter en lê meer in radiale rye as die protoxileemelemente. In die metaxileem kom, buiten die xileemparenchiem, ook tracheale elemente voor met spiraal-, leer- en netverdikkings op die wande. Die spirale van metaxileemvate is nog dig op mekaar as gevolg van min lengtestrekking.

Terwyl differensiasie van floëem en xileem plaasvind, vergroot die prokambiumstring nog deur seldelings in die middel van die string. Die delings word geleidelik meer periklinaal georiënteer en die prokambiumselle vertoon al meer 'n afgeplatte vorm. Die derivate van die prokambium (veral die metaxileem en -floëem) toon dus al meer 'n radiale rangskikking van elemente (ongeveer 1—1·6 mm en 1 mm onder die top by *P. repens* en *L. adscendens* onderskeidelik).

Terwyl meer metaxileemvate gevorm word, verloor die protoxileemvate geleidelik hul funksie, vanaf ongeveer 1—1·6 mm onder die top by *P. repens* en 1·0—1·4 mm by *L. adscendens*. Aangesien die spiraalvormige wandverdikkings van die protoxileemelemente ver uitmekaar gerek is as gevolg van groot lengtestrekking, word die sagte dele tussen die verdikkings maklik platgedruk deur naburige selle. In die baie jong stingel besit die xileemparenchiemselle dun, onverhoute selwande en lewende protoplaste, maar later verdik en verhout die wande van sommige sodat groepe xilêre vesels aan die binnerande van die vaatbundels gevorm word. Deels inmekaargedrukte xileemelemente is as verdikte selwandgedeeltes tussen die selwand van die jong xilêre veselselle te onderskei (fig. 8).

Die jong vaatbundels lê in 'n onreëlmatige kring, met murgstrale van jong parenchiemselle daartussen (fig. 7). Enkele verspreide vaatbundels is in die skors aanwesig as blaarspore. Die murgstrale (interfassikulêre parenchiem) ontstaan uit die oorblywende gedeeltes van die meristeemring, nadat die prokambiumstringe gevorm is. Die interfassikulêre ruimtes is aanvanklik agt tot twaalf selle breed, maar omdat nuwe vaatbundels nog gedurig daar ontstaan, lê die vaatbundels later dig teenmekaar met smal murgstrale, gewoonlik een, soms twee tot drie selle breed, tussenin.

Die dwarssneereekse is gemaak tot ongeveer vier of vyf mm onder die apikale meristeem, waar volwasse primêre vaatweefsel (d.w.s. vaatbundels met proto- en metaxileem en metafloëem) aangetref word. Die stingel van *P. repens* is hier ongeveer 3·66 mm in deursnee en besit 60—78 vaatbundels in die kring. Dié van *L. adscendens* is ongeveer 1·42 mm in deursnee en besit 35—38 vaatbundels.

OPSOMMING

Die bou van die stingelgroeipunt en differensiasie van die prímêre weefsels onder die groeipunt is by *Protea repens* (L.) Linn. non Thunb. en *Leucandendron adscendens* R. Br. ondersoek en vergelyk. Dit stem tot 'n groot mate by die twee soorte ooreen. In die apikale meristeem is 'n tunica van twee lae en 'n corpus te onderskei. Drie sitohistologiese sones kom voor, nl. 'n sentrale sone, perifere sone en ribmeristeem. Differensiasie van die skors, murg en prokambiumstringe en vaatweefsel is nagegaan. Die prokambiumstringe differensieer akropetaal; primêre floëem differensieer akropetaal daarin; primêre xileem differensieer akropetaal en basipetaal vanuit die blaarbasisse.

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NOTES ON MESEMBRYANTHEMUM AND ALLIED GENERA

H. M. L. Bolus

Lampranthus stoloniferus L. Bol. sp. nov. Plantae 4 visae, ferae caespitosae glabrae, ca. 3 cm. altae, ad 5 cm. diam., deinde ramos reptantes, ad 10 cm. longos, internodiis 1—5 cm. longis, emittentes; ramuli ultimi floriferi saepius 2-foliati, steriles ad 6-foliati, internodiis inclusis; folia ascendentia, altero paris interdum subfalcato, supra visa linearia, superne leviter angustata, obtusa vel subacuta, lateraliter visa superne non, vel leviter, angustata, lateribus convexulis, carina obscura, superne cum marginibus interdum, vel in novellis saepius, denticulata, punctis leviter prominentibus, 1—2 cm. longa, 3—4 mm. lata diametroque; flores solitarii meridiani; pedunculus basi bracteatus; bracteae foliis similes, 6—13 mm. longae; receptaculum fere semiglobosum, ad 3 mm. longum, 6 mm. diam.; sepala 5, in flore expanso recurva, e basi superne angustata, obtusa, interiora anguste marginata, subaequilonga, ad 7 mm. longa, basi 2—3 mm. lata; petala 1—2-seriata, subaequilonga, prope basim non, vel leviter, angustata, purpureo rosea, 8—9 mm. longa, ad 1·5 mm. lata; staminodia subnulla; filamenta ca. 7-seriata, gracillima, conice conferta, alba vel prope apicem rosea, ad 4 mm. longa, interiora prope basim papillata; discus crenulatus; ovarii lobi obtuse compressi, ad. 0·75 mm. elevati; stigmata 5, gracilia, 4—5 mm. longa; capsula infra fere semiglobosum, punctata, 8 mm., expansa 1·2 cm., diam., supra obscure angulata, fere plana, suturis vix ad. 1 mm. elevatis, carinis insigne profunde laceratis.

Cape Province: in dit. Sutherland; "55 miles E. of Karoopoort, alt. 3,900 ft." June 1965, *F. J. Stayner*. Karoo Garden 214/65.

Lampranthus vredenburgensis L. Bol. sp. nov. (*Lunati*).—Diffuse ramosus; rami decumbentes, ad 15 cm., vel culti ca. 24 cm., longi, internodiis 4—30 mm. longis; folia matura ascendentia, alterum paris ± lunatum, ad 8 mm. diam., alterum saepius vix, vel non, lunatum, saepe 5—6 mm. diam., supra acuta, 5—6 mm. lata, culta ad 2·5 cm. longa, vagina ca. 1 mm. longa; flores 1—3-nati; pedunculi parum infra medium vel prope basim bracteati, ad 1·4 cm., vel culti ad 3 cm., longi; bracteae foliis similes, 8—13 [illegible]gae; receptaculum subclavatum, prope apicem leviter constrictu[illegible] longum, apice 5—7 mm. diam.; sepala 5, superne leviter incrassata, e prope [illegible]im superne leviter angustata, acuta vel obtusa, omnia ± marginata, 5—6 mm. longa, basi 2—3 mm. lata; petala subaequilonga, 2—3-seriata, e medio inferne angustata, obtusissima, laete rosea vel purpureo rosea vel interdum apud basim pallidiora, ad 8 mm. longa, 1·5—2 mm. lata; staminodia ad stamina conice conferta adpressa, prope apicem tantum recurva, ciliate papillata, dimidio inferiore albo, superiore roseo; filamenta ca. 5-seriata, rosea, ad 4 mm. longa, intima prope apicem papillata; nectarium e glandulis 5, fere semilunatis crenulatis, interdum approximatis vel fere contiguis, compositum; ovarii lobi obtuse compressi, ad 1 mm. elevati; stigmata 5, anguste subulata, profunde posita, atre purpurea, 1·5—2 mm. longa.

Cape Province: in dit. Malmesbury; Vredenburg, "8 miles from Saldhana Bay," *H. Hall* 2793. N.B.G. 345/64. Fl. Aug. 1965. "Occasional near coast on granite outcrops. It appears to change in cultivation rather swiftly."

Lampranthus nelii L. Bol. sp. nov. (*Adunca*).—Planta 1 visa, fera gracilis, 14 cm. alta; rami 1—1·5 mm. diam., internodiis 6—20 mm. longis; folia fere erecta, conspicue aristata, praecipue in novellis, dorso rotundo, 1—1·7 cm. longa, 1—1·5 mm. diam.; pedunculi 1—1·3 cm. longi; receptaculum obconicum, 2 mm. longum, ad 4 mm. diam.; sepala 5, e parum supra basim angustata, aristata, arista 1—3 mm. longa, omnia ± ustulate marginata, in floribus senectis valde recurva, 6—8 mm. longa, basi 2—3 mm. lata; petala 2—3-seriata laxa, inferne leviter angustata, obtusa rosea, inferne pallidiora, 9—10 mm. longa, saepius 1 mm. lata; staminodia ad stamina conice conferta appressa eaque bene superantia, inferne ciliate papillata et alba, deinde rosea, apicem versus alba, filamenta 3—4-seriata, alba, ad 4 mm. longa, intima prope apicem dense papillata, antheris pollineque ochraceis; discus sat conspicuus, crenulatus; ovarium ad 1 mm. elevatum, lobis obtuse compressis; stigmata 5, gracilia, stamina bene excedentia, ad 6 mm. longa.

Cape Province: in dit. Cape; Fisantekraal, Jul. 1965, *J. E. Nel.* Bolus Herbarium 27732.

This species is chiefly distinguished by the long slender stigmas which well exceed the stamens.

Cheiridopsis albiflora L. Bol. sp. nov. (*Eucheiridopsis*)—Planta 1 visa, cum flore clauso ca. 7 cm. alta, 8 cm. diam; caulis 8 mm. diam.; rami primarii ad 4 mm. diam.; partes herbaceae ± velutinae, glauce virides, inconspicue punctatae, punctis viridibus; ramuli floriferi 2-foliati; folia matura ascendentia, supra visa e parum infra medium superne leviter angustata, acuta vel subobtusa, breviter aristata, arista persistente, ad 4·4 cm. longa cum vagina ad 8 mm. longa, 6—9 mm. lata, lateraliter visa superne ± ampliata, rotunde truncata, obtuse carinata, lateribus convexulis, supra medium ad 1·2 cm. diam.; gemmae axillares 4-foliatae; folia inferiora 2—3·5 cm. longa cum vagina pellucida ad 2·7 cm. longa, superiora lateraliter visa superne leviter ampliata, acute carinata, ad 2 cm. longa; pedunculus in vagina bractearum interdum inclusus, ad 1 cm. longus; bracteae foliis subsimiles, ad 2·5 cm. longae cum vagina ad 1·1 cm.

longa, ad 1 cm. diam.; receptaculum semiglobosum, 4—5 mm. longum, 9—10 mm. diam.; sepala 5, exteriora carinata aristata, interiora marginata, prope apicem compressa, 6—8 mm. longa, basi 5—7 mm. lata; petala densa, ca. 6-seriata, ex infra medium inferne angustata, obtusa vel interiora acuta, nitente nivea, in flore maximo ad 2·2 cm. longa, ad 2 mm. lata; filamenta ca. 4-seriata, basim versus incumbentia, deinde erecta, alba, ad 6 mm. longa, antheris pollineque albidis; discus inconspicuus crenulatus; ovarium supra in dimidio exteriore planum, deinde leviter elevatum, lobis dorsale complanatis; stigmata 10, angustissime subulata, 3—4 mm. longa; capsula pallide cinerea, infra apud basim fere plana, ad 4 mm. longa, 1·1 cm., expansa 1·8 cm., diam., valvis valde reflexis, alis angustissimis, superne liberis, carinis saturate brunneis, inferne parallelis, superne patentibus, dimidium valvae non attingentibus, rigide ciliatis vel rarius lacerulatis, supra circa marginem plana, medio ad 2 mm. elevato, suturis leviter compressis, 0·5—0·75 mm. elevatis.

Cape Province: Namaqualand; Kinderlé Mountain, *P. van Heerde*. Fl. hort. van Heerdei Aug. 1965. Bolus Herbarium 27731.

"Collected a few months ago and now flowering in my garden. It is a beautiful flower." (*P. van Heerde*).

Mesembryanthemum liebendalense L. Bol. sp. nov.—Plantae 15 visae, ferae erectae gracillimae, cum floribus 3—6·5 cm. altae, ad 3 cm. diam.; partes herbaceae virides, nitente papillosae, papillis rotundis parvis; caulis ad 2 mm. diam., e basi ramosus; rami ascendentes vel inferne patentes, superne erecti; folia mox marcescentia, linearia, supra plana vel leviter concava, superne angustata, acuta vel vix angustata, obtusa, dorso rotundo, 6—15 mm. longa, 1·5—2 mm. lata diametroque, infima opposita, suprema receptaculum attingentia; flores solitarii subsessiles; receptaculum obtuse 5-angulatum, 2—3 mm. longum, 1·5—4 mm. diam.; tubus calycis 1—2 mm. longus, segmentis 5, linearibus vel lanceolate linearibus, obtusis vel acuminatis, 6—9 mm., vel rarius ad 11 mm., longis, basi 1—1·75 mm. lata; tubus corollae 2—3 mm. longus, segmentis ca. 3-seriatis, subaequilongis obtusis, omnino albidis vel superne pallide roseis, ad 8 mm., vel in flore maximo viso ad 20 mm., longis, 0·5—0·75 mm. latis; staminodia pauca; filamenta ca. 3—4-seriata, sat pauca, dimidium, vel partem tertiam, corollae attingentia, antheris ante dehiscentiam ad 2·5 mm. longis, cum polline luteis, demum albis; ovarii lobi sat acute compressi, ad per 2 mm. elevati; stigmata 5, gracilia, superne leviter angustata, 5—10 mm. longa cum cauda 1 mm. longa.

Cape Province: in dit. Vanrhynsdorp; "on the farm 'Liebendal,' near Vredendal, Nov. 1964," *H. Hall* 2882.

"This little midget grew in enormous numbers on the farm Liebendal." (*H. Hall.*)

Conophytum novicium N. E. Br. forma—Plantae plures visae, glabrae, ad 2·5 cm. altae et 5 cm. diam.; rami reliquiis persistentibus dense vestiti, ad 2 cm. longi; ramuli floriferi sine flore 1·5 cm. longi; vagina persistens anni prioris inferne pergamentacea polita brunnea, superne subpapyracea, albida, conspicue atre punctata; corpuscula piriformia vel elongate piriformia, supra medium ampliata, 7—12 mm. longa, apice 6—9 mm. diam., convexulo, sparse saturatiore viride punctato, vel circum os punctis saepe coalescentibus, ore levissime ringente, ad 2 mm. longo; pedunculus ad 3 mm. longus, prope basim bracteatus, bracteis non bene visis, parvis; receptaculum 1 mm. longum, 1·5 mm. diam.; calyx membranaceus, ad 6 mm. longus, segmentis 4—5, obtusis, 1—1·5 mm. longis; corolla 1·5—1·9 cm. longa, tubo albo, 6—9 mm. longo, segmentis ad 18, 2—3-seriatis, interioribus perpaucis, obtusis vel obscure emarginatis, laxis, laete luteis, ad 1 mm. latis; filamenta ca. 5-seriata, sat pauca, e prope medium tubi adnata, fere omnia exserta, interdum aurantiaca, antheris pollineque luteis; discus crenulatus; ovarium circa marginem concavum, medio subconice elevato, altitudinem disci attingens; stylus 7—8 mm. longus; stigmata 4—5, ad 4 mm. longa; capsulae 2 visae, 2·5—3 mm., expansae 5—6 mm., diam., pallidae, infra brevissime obconicae, ca. 1·25 mm. longae, supra obtusissime angulatae, medio ad 1 mm. elevato, valvis apertis parum supra medium transverse rubre lineatis, pedunculo ad apicem alato, ad 4 mm. longo.

Cape Province: Namaqualand: Anenous Pass, *H. Hall* 2768. Fl. Apr. 1965. N.B.G. 247/64.

Conophytum distans L. Bol. sp. nov. (*Derenbergia*—caespitosa-lutea-vestita).—Corpuscula in circuitu late obovata, asperula, 4—5 cm. longa, manu complanata ad 4 cm. diam., divergio 1·5—2 cm. longo, vagina ad 3 cm. longa, medio ad 1·7 cm. lato, apice, manu complanato, ad 3·2 cm. diam., parte pellucida in latere altero anguste cuneata vel subquadrata, altero longiore, parce viride punctata, lobis inaequalibus, 1·5—2 cm. longis, subobtusis, basi ad 1·3 cm. lata, altero 1·3 cm., altero ad 2·1 cm., diam., truncatis vel subtruncatis, interdum leviter excavatis et lobum parvum formantibus; pedunculi ad 1·7 cm. longi; bracteae arte amplectentes, obtusae, 8 mm. longae, vagina 5 mm. longa; calyx herbaceus, 1—1·3 cm. longus, tubo 4—5 mm. longo, segmentis 6, obtusis, anguste marginatis, 5—8 mm. longis, fere ad 2 mm. latis; corolla lutea, 2·3 cm. longa, tubo ad 1 cm. longo, segmentis ca. 4-seriatis obtusis, ad 1·5 mm. latis; stamina ca. 6-seriata, e basi corollae adnata, superiora dimidium segmentorum corollae fere attingentia, filamentis superioribus aureis, antheris pollineque primum luteis; discus inconspicuus; ovarium circa marginem concavum, deinde conice elevatum, in flore senecto fere ad 2 mm., lobis leviter et obtuse compressis; stylus 6 mm. longus; stigmata 6, 5—6 mm. longa; capsula

infra globose obconica, 3 mm. longa, 7 mm., expansa 1·4 mm., diam., valvis e basi valde recurvatis, supra 6-angulata, ad 3 mm. elevata, suturis leviter compressis, dimidio superiore valvarum claudentum erecto manente itaque capsula iterum non omnino clausa.

Cape Province: Namaqualand; Eenriet, *P. A. B. van Breda* 899. Fl. Veld Reserve, Worcester May 1965.

The subgenus *Derenbergia* of **Conophytum** may be divided roughly into the following groups and subgroups.

KEY TO THE GROUPS AND SUBGROUPS.

1. Branches elongating—e.g. *C. altum, C. frutescens* .. .. .. ALTA
1. Branches forming mats (caespitose)—e.g. *C. bilobum* .. .. .. CAESPITOSA
  2. Petals yellow or very rarely white .. .. LUTEA
    3. Bodies smooth—e.g. *C. pole-evansii* .. .. GLABRA
      4. Bodies with darker green dots—e.g. *C. sororium* .. .. PUNCTATA
      4. Bodies without dots—e.g. *C. ampliatum* .. .. .. EPUNCTATA
    3. Bodies pubescent or ± rough—e.g. *C. meyeri, C. latum* .. VESTITA
  2. Petals purple-rose, rose, pale rose, or rarely white .. .. .. ROSEA
    5. Bodies with darker green dots—e.g. *C. ernianum* .. .. PUNCTATA
    5. Bodies without dots—e.g. *C. blandum* .. .. EPUNCTATA

CORRECTION

Vol. 31: 238, line 30. For L. Dabneri read F. Dabner.

Note.—The type specimens of all new species described in this paper are in the Bolus Herbarium, University of Cape Town.

(*To be continued*)

A NEW SOUTH AFRICAN HUERNIA

J. J. Lavranos

(With Plates XLVIII and XLIX)

Huernia kennedyana Lavranos. Nova species, affinis *H. volkartii* Gossweiler, sed caulibus globosis, tesselatis-tuberculatis, polygonis, pedicellis longioribus, corolla breviore, lobis coronae interioris brevioribus differt.

Caules globosi, ca. 20 mm. longi, 20 mm. diam, virides, hexa-vel octagoni, tesselati-tuberculati, tuberculis primum acutis, aetatae obtusiusculis; *flores* bini, ex basi caulium producti; *pedicelli* teretes, glabri, 15 mm. longi, 1·5 mm. diam; *sepala* deltoidea, acuta, 3 mm. longa; *corolla* campanulata, 10 mm. longa, 22 mm. diam. inter apices loborum, extus punicea, sparse et minute rubropunctata; *tubus* 6 mm. longus, intus basi glaber, maculis rubrobrunneis punctatus; *lobi* deltoidei, 7 mm. lati, 6 mm. longi, apice acuto paulo reflexi, transverse rubro-brunnei striati; *lobi intermedii* 1 mm. longi; lobi et tubi pars superior intus papillis albescentibus, validis, a 2·5 mm. longis, induti; *corona exterior* rotata, 5-lobata, basi tubi adpressa, albida; *coronae interioris* lobi

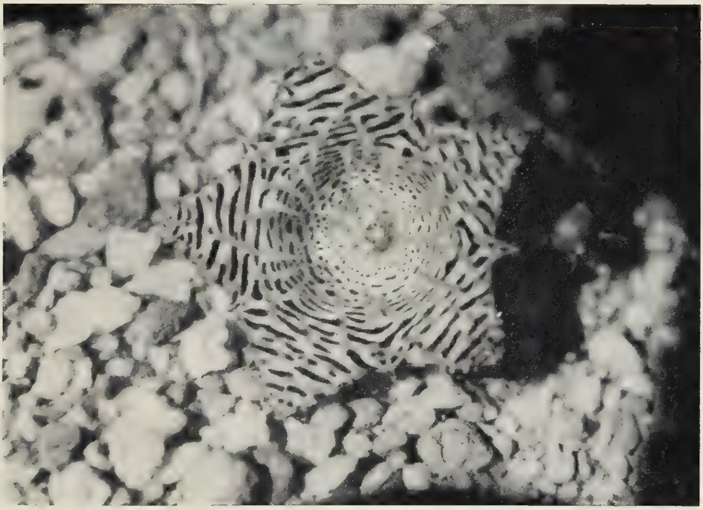

Plate XLVIII
H. kennedyana Lavranos Flower x 2·5

adscendentes-erecti, apice divergentes, acutiusculi, dorso gibbosi, laete flavi, supra antheras incumbentes sed eas excedentes.

Habitat. Farm Welbedaght, 10 miles from Cradock on the road to Graaff-Reinet, Kennedy in Lavranos 2356 coll. January 1964, fl. Bryanston, Johannesburg, April 1964, (PRE.) holotype.

DESCRIPTION

Stems globose, 6—8 angled, green, glabrous, appr. 20 mm. long, 20 mm. diam., tesselate-tuberculate, the tubercles first acute, becoming obtuse with age.

Flowers in pairs from the base of young stems, developed successively.

Pedicel 15 mm. long, 1·5 mm. diam. terete, glabrous.

Sepals deltoid, acute, 3 mm. long.

Corolla 10 mm. long, 22 mm. diam. between apices of lobes; *tube* campanulate 6 mm. long; *lobes* deltoid, 7 mm. broad at base, 6 mm. long, their acute apices somewhat recurved; *intermediate lobes* 1 mm. long; *outer surface* pinkish-cream, sparsely covered with small, round, purple-brown dots and with 5 rather prominent nerves radiating to each lobe, the apices of the lobes carinate; *inner surface* cream with red-brown dots and short transverse bands, glabrous at base and lower part of tube, thereafter covered with fleshy papillae which are up to 2·5 mm. long, whitish with red-brown markings;

Outer Corona adpressed against the corolla-tube, rotate, appr. 5 mm. diam., 5-lobed with rounded and shallowly indented lobe-apices, white with brown-red margin and a few small reddish spots.

Inner Corona lobes bright yellow, erect at first, then ascending-convergent, incumbent upon and twice as long as the anthers, their apical portions somewhat diverging, the apices rounded.

H. kennedyana is a most interesting species. In floral characters it seems to be related to *H. volkartii* Grossweiler, from Angola and Northern South West Africa and to *H. repens* Lavranos from Mocambique, but its corolla is more campanulate, with a shorter tube, while the outer corona is white and the inner corona lobes bright yellow and shorter than is the case in its two allies, while the pedicels are longer.

In its habit of growth, however, and in the form of its stems *H. kennedyana* is quite unique. The stems are globular, 6—8 angled and rather tesselate than tuberculate, being identical to those of some species of *Duvalia* or *Piaranthus* and both Mr. Kennedy and the present author did, at first, have no doubt that the Cradock plants belonged to one of these two genera. This character is not known in any other species of Huernia.

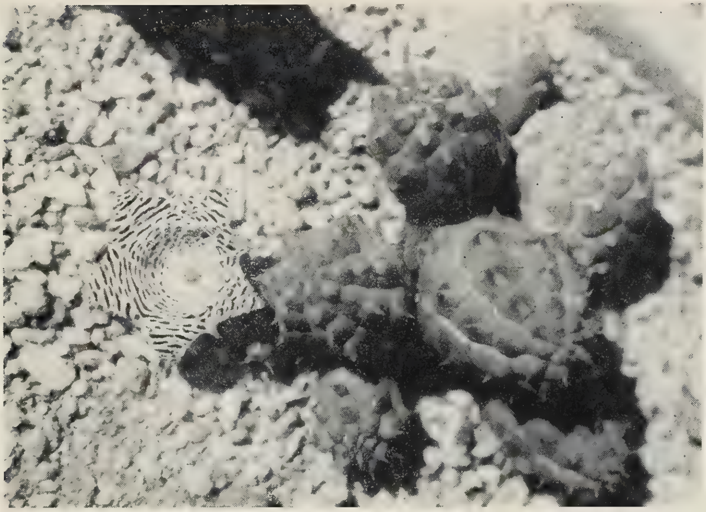

Plate XLIX
H. kennedyana Lavranos Plant approx. natural size.

This unusual species was collected, together with other plants, at the request of Mr. H. C. Kennedy of Bellville, Cape Province, during the January, 1964 school holidays by one of his pupils on Mr. A. C. A. Lombaard's farm "Welbedaght" which is situated 10 miles from Cradock on the Graaff-Reinet road. Mr. Kennedy, a keen collector and student of Stapeliae, was good enough to send me cuttings of the few items he had received including the species herein described, which it gives me great pleasure to name after him in well-deserved recognition of his active interest in the Stapeliae.

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Note: New species, etc., are printed in bold type. An asterisk indicates that the species is illustrated.

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